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## **Contextual deprivation, daily travel and road traffic injuries among the young in the Rhône *Département* (France)**

**Idlir Licaj<sup>a,b,e</sup>, Mouloud Haddak<sup>a,b,e</sup>, Pascal Pochet<sup>c,d,e</sup>, Mireille Chiron<sup>a,b,e</sup>**

<sup>a</sup> Ifsttar (Institut français des sciences et technologies des transports, de l'aménagement et des réseaux), UMR T9405 (Umrestte), 25 Avenue François Mitterrand, Bron F-69675, France

<sup>b</sup> Université Lyon 1, Lyon F-69003, France

<sup>c</sup> Laboratoire d'Economie des Transports, ENTPE, Université Lyon 2, CNRS, UMR 5993, rue Maurice Audin, 69518 Vaulx-en-Velin Cedex, France

<sup>d</sup> CNRS, Université Lyon 2 F-69007, France

<sup>e</sup> Université de Lyon F-69008, France

### **Abstract**

This study investigated the effect of the socioeconomic level of the municipality of residence on personal injury road traffic accident risk among young persons of 10-24 years of age in the Rhône *Département*. This effect was assessed by comparing incidences of injuries (n = 2,792 casualties) on the basis of three denominators: the resident population of young people, the number of users of each mode and the distances covered by each mode. The results are presented for each type of road users (pedestrians, car passengers, car drivers, motorised two-wheeler riders, cyclists, public transport users).

Young persons from deprived municipalities use motorised-two wheelers, bicycles and the car (as passengers and drivers) less frequently, they walk more and take public transports more often than those from other municipalities.

When considering injury risk, motorised two wheeler injuries among adolescent males, for example, are significantly less frequent in deprived municipalities. But the motorised two-wheeler riders as well as car

passengers from deprived municipalities are characterized by an excess injury risk, whether the selected denominator is the number of users or the kilometres travelled by this mode.

For the first time in France, this study has enabled a comparison of the effects of a contextual socioeconomic indicator (the type of municipality of residence, deprived, or not) on daily travel practices and injury incidences among the population, among the users of each mode and per km of travel.

## **1 Introduction**

Worldwide, road traffic injuries are the principal cause of mortality among young people in the 10-24 year-old age bracket (WHO 2007). A number of studies have shown that young people belonging to underprivileged social groups have more road traffic injuries than their more socially advantaged counterparts (Cubbin et al. 2000; Hasselberg et al. 2001; Hippisley-Cox et al. 2002; Ferrando et al. 2005; Edwards et al. 2008; Fleury et al. 2010). The evidence suggests that explanations for these differences should be sought in variations in exposure to risk, rather than in behaviour (Laflamme 1998), though behavioural differences do play some role. Exposure to road risk is defined on the basis of the conditions and forms of travel and the number of trips. Some studies employ measures of risk exposure such as distance travelled, number of intersections crossed or trip duration. (Thouez et al. 2005; Spallek et al. 2006; Jungwook et al. 2007a; Jungwook et al. 2007b).

In France, and particularly in the Rhône *Département*, road traffic injuries peak for males between 15 and 17 years of age and for females between the 22 and 24 years of age (Haddak et al. 2010, forthcoming ). The minimum legal age for riding a motorized two-wheeler is 14 and for driving a car 18 (except in the case of accompanied driving for 16-17 year-olds).

Although the study of leisure trips is essential in order to gain an understanding of how young people acquire the capacity for independent travel (Massot and Zaffran 2007), investigation of the daily mobility of children and adolescents has primarily focused on their home-to-school trips (Hjorthol and Fyhri 2009). Various studies have shown that children's travel practices are strongly dependent not only on

their age and gender but also on their parents' standard of living and their residential location (Van Vliet 1983; Paulo 2006; Pochet et al. 2010). The ownership or mere availability of one or more cars within the household is a key variable for understanding modal choice amongst the young. However, in France, the ease of access to a car is determined not only by residential location, but also by the household's standard of living (Claisse et al. 2000; Orfeuill 2004; Mignot and Rosales-Montano 2006). Low income households less frequently own two vehicles than high income households, and more frequently own no vehicle at all. In addition, they more often purchase secondhand cars and the higher average age of their vehicles (Nicolas et al. 2003) may affect their availability and influence crash risk and severity, particularly in the case of young male drivers, as has been observed in the United States (Males 2009). The expensive cost of procuring a driving licence may affect the daily travel of low income young and therefore have consequences on social exclusion, on the example of non-western immigrants in Norway (Priya and Uteng 2009).

The combined use of data on daily travel and road traffic injuries is still unusual in epidemiological studies. The main reason for this is that the necessary data is difficult to collect. Several measures are used to define road risk exposure, for example, the distance travelled (Pucher and Dijkstra 2003; Harrison and Christie 2005), the number of trips (Pucher and Dijkstra 2003; Rice et al. 2003), the number of streets crossed in the case of pedestrians (Posner et al. 2002) and journey times (Lee and Abdel-Aty 2005). A Canadian study from some years ago (Macpherson et al. 1998), after showing that underprivileged children between the ages of 5 and 12 crossed more roads on foot, demonstrated that there is a strong positive correlation between the number of roads crossed and the number of pedestrian injuries. However, most of these studies considered a single transport mode and did not include socioeconomic data.

This paper compares road trauma data (from the Rhone road trauma registry) with travel data in order to gain a better understanding of the origin of the social and geographical inequalities with regard to road traffic injuries which are observed in France and other industrialized countries.

The goals are as follows: first, to investigate the effect of the socioeconomic level of the municipality of residence on the use of different transport modes by young persons of 10-24 years of age in the Rhône

*Département*, and second, to investigate the effect of the socioeconomic level of the municipality on personal injury road traffic accident risk as assessed on the basis of three denominators: total population, the number of users of each mode and the distances covered by each mode.

## **2 Material and methods**

### **2.1 The Rhône Département and the Deprived Areas**

The Rhône is a French *Département* (1,600,000 inhabitants) in the Rhône-Alpes Region whose main urban centre is the Lyon conurbation (1,200,000 inhabitants).

France has so-called *Zones Urbaines Sensibles* (ZUS) which are deprived areas which have been identified by the public authorities as priority targets for urban policy. These areas are characterized by large apartment buildings and relatively poor housing conditions, a pronounced imbalance between the number of dwellings and the number of jobs and low incomes. In addition, ZUS residents are more often in casual employment than those living in other areas.

The Rhône contains 293 municipalities and has a population of 1,669,600 of which 191,682 (11.5%) live in 30 ZUS's which are spread over 25 municipalities (INSEE 2006). Some municipalities have two or even three ZUS's. Also at the time of the last census (1999), the unemployment rate stood at 22.4% in the Rhône's ZUS's, compared with 11.4% in the *département* as a whole. In addition, the under 25 year-old age group, individuals with no qualifications and single parent families were over-represented in the ZUS's: in the ZUS's the under-25s accounted for 39.2% of the population, unqualified persons (without any formal academic qualifications) accounted for 33.3% of the population and single parent families accounted for 21.5% of the population, while the percentages for the rest of the Rhône were respectively 33.0%, 18.7%, and 13.0%.

The above characteristics show that living in a ZUS would seem to be a good indicator of poor social position. However, our data only report the residential municipality of casualties. We therefore decided to use living in a municipality with one or more ZUS's (deprived municipalities, in opposition with other

municipalities: without ZUS) as an indicator. In such municipalities, on average 35% of persons of under 25 years of age live in a ZUS. In order to obtain an accurate evaluation of this socio-geographical indicator we shall compare the median taxable income per consumption unit in the two types of municipality (INSEE France 1999). The median income in the municipalities with a ZUS was €15,719 per year with an interquartile interval of [12,308-16,120] whereas in the municipalities without a ZUS, the median annual income was €19,789 with an interquartile interval that is disjoint from the previous one [17,544-21,829]. The use of this sociogeographical indicator thus allows us to consider urban contexts which are contrasting with regard to the incomes of their residents.

## **2.2 The Rhône Registry**

The Registry contains all the individuals who sustain injuries in road traffic accidents in the Rhone Département. A total of 282 public and private health care departments to which road traffic accident casualties may be taken contribute data to the Registry. It was developed by the UMRESTTE, in collaboration with the *Département's* Fire and Emergency Service and the Rhône *Département* Road Trauma Registry Association (ARVAC) (Laumon et al. 1997). Certain details about the accident (location, date, time of day, vehicles involved) and some personal data about the casualty are recorded. The inclusion criteria are the location of the accident (Rhône), an accident involving a moving vehicle (including roller-skates and skateboards), and the presence of at least one AIS injury (AIS 1990 Revision). Pedestrians who fall on their own are therefore not included.

The municipality in which the accident occurs was classified according to whether or not it contained a ZUS. In the case of the city of Lyon, each district was considered to be a municipality. Casualties injured in the Rhône but living outside the Rhône (14%) were excluded.

## **2.3 The 2005-2006 Household Travel Survey**

The Lyon Household Travel Survey (HTS) we used was conducted between November 2005 and May 2006. This survey is representative of the population of households living within the study area, which includes the entire Rhône *Département*. In the 2,968 surveyed households in the Rhône, the 5,102 persons

aged over 4 years who were interviewed individually provided information about their personal characteristics and mobility on one day. Mobility was identified on the basis of all the trips made the day before the interview. In addition, the survey collected details about respondents' customary mode use, asking them to choose between six alternatives with regard to weekday travel:

1. Every day or almost,
2. At least two trips per week,
3. At least two trips per month,
4. On an exceptional basis,
5. Never

Details on customary usage were collected for the following modes:

- Motorized two wheelers (denoted by M2W),
- Car as a passenger,
- Car as a driver,
- Public Transport (PT),
- Bicycle.

The question about respondents' travel behaviour, both customary and on the day before the survey related to weekdays outside school holidays.

We constructed a binary variable for each transport mode. Mode use varied greatly in intensity between the different modes. That is the reason why, in the case of rare modes or modes with a high per kilometre injury risk such as M2Ws and bicycles, the binary risk exposure variable contrasted those who used the mode, even exceptionally, with those who did not (items 1, 2, 3, 4 versus 5). The same contrast was chosen in the case of car drivers. In the case of car passengers and public transport users, who were more frequently among the young, the contrast was between very frequent users and non-users, which in this case also included occasional users (items 1 vs 2 to 5).

The frequency of usual walking was not described in the HTS on the grounds that walking is a generalized practice either as a distinct travel mode or as in addition to another mode. We have used the

characteristics of individuals' travel the day before the interviewer visited the household (walking trips conducted on a standard day, during the week and outside school holidays), making a dichotomic distinction between individuals who used walking as a distinct mode of transport and those who did not.

In the case of the trips made the day before the interview, the distances covered by each mode are also estimated. We consider that these are representative of the distances covered by all users on weekdays.

The results that are presented involve weighted data, representing a projection of the Rhône *Département* HTS sample to this entire area. The weight assigned to each household in the survey depends on the sampling rate in its zone, corrected by a factor based on the average size of the households in the zone.

The survey contained 46% of young people living in a municipality with a ZUS while, based on the 2006 INSEE census, the percentage of young people living in such a municipality was 54%.

## **2.4 Analyses**

The analyses covered young people of 10-24 years of age living in the Rhône *Département* on the basis of three age categories: 10-13, 14-17 and 18-24 years.

Initially, the use of the different transport modes was described on the basis of age, gender, and municipality type (with a ZUS, i.e. deprived, and other municipalities without a ZUS): rate of use of the various modes and kilometres travelled on weekdays outside school holidays. When the mean distances travelled were not significantly different between deprived and other municipalities we have presented a single mean distance with its 95% confidence interval for each mode and for the three age classes. When the distances covered were different in the two types of municipalities, both values have been given. The comparisons have been made with *surveymeans* procedure in SAS software (Cassell 2006)

The incidence ratios (incidence rate in deprived municipalities/incidence rate in other) for injury accidents according to age and gender and each mode were then calculated, taking in turn as denominators for incidence rates the total populations, the number of users for each transport mode as defined in Section 2.3 and the number of kilometres travelled by the users in question. The number of customary users was



calculated by applying the rate of use obtained in the HTS to the population of the two categories of municipalities in the *département*.

In order for these incidences to be meaningful, we will retain only those injuries that occurred outside weekends and outside school holidays in 2005-2006 in our calculation instances. All the statistical analyses were performed using the SAS software package (version 9.2).

### 3 Results

#### 3.1 The effect of the type of municipality on the use of transport modes

##### 3.1.1 The use rates for the different modes

A total of 3,885 young persons aged between 10 and 24 years were interviewed in the Rhône *Département*. After weighting, the distribution of the population (305,168) according to age and gender was as follows: 27% between 10 and 13 years; 30% between 14 and 17 years and 51% were males. Table 1 shows the percentages of individuals for each category of age, gender and type of municipality.

**Table 1 Use of modes (%) according to municipality of residence (deprived, other), gender and age**

	Deprived municipalities							Other municipalities						
	10-13 years		14-17 years		18-24 years		All	10-13 years		14-17 years		18-24 years		All
<b>Males</b>														
<b>Population</b>	18982		20010		53082		92075	22150		22986		37213		82 348
<b>Car pass.</b>	6357	29%	3654	16%	2821	7%	15%	11992	55%	7774	31%	3446	14%	32%
<b>Car driver *</b>	-	-	514	5%	23839	62%	50%	-	-	1647	15%	16488	66%	50%
<b>M2W</b>	-	-	1201	5%	2681	7%	6%	-	-	4583	18%	3185	13%	15%
<b>Bicycle</b>	11167	51%	12702	57%	18818	49%	52%	15328	70%	14792	69%	11843	47%	58%
<b>Pedestrian</b>	14274	65%	11361	51%	11592	30%	45%	10042	46%	8861	35%	7674	31%	37%
<b>Public transport</b>	4198	19%	11667	52%	18897	49%	42%	3499	16%	9930	39%	9412	38%	32%
<b>Females</b>														
<b>Population</b>	18468		19686		60838		98992	21132		21572		37565		80269
<b>Car pass.</b>	4385	25%	4044	21%	3968	9%	15%	10368	53%	7617	35%	3841	14%	32%
<b>Car driver *</b>	-	-	814	8%	22713	50%	43%	-	-	1901	15%	19015	70%	52%
<b>M2W</b>	-	-	548	3%	920	2%	2%	-	-	1469	7%	1353	5%	6%
<b>Bicycle</b>	7175	40%	6830	36%	16944	38%	38%	9394	48%	8695	40%	10479	39%	42%
<b>Pedestrian</b>	10890	61%	9083	47%	18627	41%	47%	9477	49%	6063	28%	7029	26%	33%
<b>Public transport</b>	5436	31%	10602	55%	25969	58%	51%	3234	17%	9059	42%	12483	46%	36%

- 1- Car passenger, public transportation : daily or almost daily use on weekdays
- 2- Car driver M2W and bicycle users : regular or exceptional use on weekdays
- 3- Walking the day before the survey, on weekdays outside school holidays

For example, 15% of the young males in the deprived municipalities travelled everyday or almost everyday as car passengers, while 45% had made a walking trip the day before the interview and only 6% used a M2W both on a regular or an exceptional basis.

Car use (as a passenger and driver) was fairly similar among young males and young females, however it was very much linked to the socioeconomic level of the municipality of residence. For all age and gender categories, car travel was approximately half as common among young people from deprived municipalities as among their counterparts from other municipalities.

Likewise, driving a car (regularly or on an exceptional basis) was less common in deprived municipalities, and this was particularly true for young males aged between 16 and 17 years (3 times less) and young females aged between 18 and 24 years (1.4 times less).

Whatever the type of municipality, 3 times more young males used M2Ws. Overall, and for each of the two relevant age categories, three times fewer young persons from deprived municipalities reported M2W use than those living in other municipalities.

For both types of municipalities, bicycle use was more frequent among young males. Bicycle use (both regular and exceptional) was lower in deprived municipalities for both genders, particularly among 10-13 year-olds, while there was almost no difference between deprived and other municipalities among 18-24 year-olds.

In the case of walking, no marked gender effect is apparent. However, the use of walking was greater in deprived municipalities, particularly among 10-17 year-olds.

Public transport use is a specific case, it was the young females from deprived municipalities who used public transport most, followed by young males from deprived municipalities while those who used it least were the young males from other municipalities.

### **3.1.2 Distance travelled by the young persons, for each mode**

*Among children of 10-13 years of age*, the daily distances travelled by users of each mode on the day before the survey were, on average, 2.1 km [1.9-2.3] by foot, 5.3 km [4.5-6.1] by bicycle, 10.0 km [8.9-11.0] by car as a passenger and 9.6 km [8.5-10.6] on public transport.

*For the 14-17 year olds*, the daily distances were higher: on average, this group covered 2.6 km [2.4-2.8] on foot, 6.3 km [3.5-9.1] by bicycle, 11.9 km [7.6-16.3] by M2W and 14.0 km [12.4-15.7] by car as a passenger, 10.6 km [6.7-14.4] as a car driver and 16.1 km [15.0-17.2] on public transport.

Young persons of between 10 and 17 years of age in deprived municipalities travelled longer distances by foot and by M2W. The opposite applies for the other modes (car, public transport and bicycle). These differences are not statistically significant.

*Among young persons of 18-24 years of age*, the daily distances travelled were on average 2.3 km [2.0-2.6] on foot, 9.3 km [5.4-13.2] by bicycle, 22.7 [11.8-33.6] by M2W, 30.8 [28.4-33.1] as car drivers and 17.6 km [15.2-19.9] as car passengers

The young persons aged between 18 and 24 living in a deprived municipality also covered longer distances on foot than those from other municipalities. The young males from deprived municipalities also covered longer distances by bicycle. However, both the young males and young females from deprived municipalities travelled shorter distances than those from other municipalities by car and M2W. These differences were not significant.

Young females from deprived municipalities also travelled shorter distances on public transport (14.9 km [13.2-16.6] vs 22.1 km [19.2-25.0]) than the young females from other municipalities. Similarly, the young males from deprived municipalities travelled shorter distances by public transport (deprived vs other: 16.7 km [14.9-18.6] vs 23.5 km [19.6-27.4]).

Ultimately, the distances travelled by each mode by the young males and females were fairly similar.

### **3.2 The influence of the type of municipality on injury frequency**

In the Rhône as a whole, 6,944 young people of between 10-24 years of age were injured or killed in a road traffic accident in 2005 and 2006, and 5,945 of these lived in the *Département*. This study concentrates on the accidents involving young people that occurred outside weekends and school holidays. These involved 2,792 casualties (47%) and 321 days (44%). We removed 247 casualties (i.e. 8.8%) whose municipality of residence was unknown. Ultimately, the study included 2,545 casualties, of whom 67.6% were male. The distribution between the three age groups was as follows: 11% were aged between 10 and 13 years, 25% between 14 and 17 years and 64% between 18 and 24 years.

**Table 2 -Incidence ratios and 95% confidence interval for injuries outside school holidays 2005-2006** RhôneRegistry : Safeguard of September 2009

The gaps in the table correspond to null incidences or inadequate (or null) sample size for mode use or person-kilometres.

		N(casualties)	Per 1000 young inhabitants incidence ratio (deprived/other)			Per 1000 users of each mode incidence ratio (deprived/other)			Per km for each mode incidence ratio (deprived/other)		
			10-13 years 80 732	14-17 years 84 254	18-24 years 188 698	10-13 years	14-17 years	18-24 years	10-13 years	14-17 years	18-24 years
Male	Car as passenger	111	1.75 [0.62-4.92]	1.79 [0.77-4.14]	1.13 [0.70-1.81]	<b>3.32</b> [1.18-9.33]	<b>3.46</b> [1.50-8.03]	1.49 [0.93-2.41]	<b>3.18</b> [1.13-8.93]	<b>3.42</b> [1.48-7.90]	<b>1.79</b> [1.12-2.87]
	Car as driver	261	-	1.15 [0.16-8.16]	0.96 [0.75-1.23]	-	3.44 [0.49-24.5]	<b>0.69</b> [0.54-0.88]	-	-	<b>1.53</b> [1.20-1.96]
	M2W	754	0.78 [0.13-4.67]	<b>0.77</b> [0.60-0.96]	0.98 [0.81-1.18]	-	<b>2.76</b> [2.33-3.82]	1.20 [1.01-1.48]	-	<b>1.90</b> [1.51-2.44]	<b>6.83</b> [5.89-8.56]
	Bicycle	301	0.84 [0.54-1.31]	<b>1.71</b> [1.14-2.57]	<b>1.67</b> [1.14-2.45]	1.15 [0.73-1.80]	<b>2.07</b> [1.38-3.11]	1.08 [0.74-1.59]	<b>1.64</b> [1.05-2.57]	<b>3.08</b> [2.07-4.68]	<b>0.68</b> [0.46-1.00]*
	Pedestrian	154	<b>2.81</b> [1.60-4.97]	<b>4.74</b> [2.19-10.3]	1.14 [0.66-1.96]	<b>1.99</b> [1.13-3.50]	<b>3.25</b> [1.50-7.06]	0.78 [0.45-1.34]	1.32 [0.75-2.32]	<b>2.75</b> [1.27-5.95]	1.02 [0.59-1.76]
	Public transport	3	0	-	0	0	-	0	0	-	0
Female	Car as passenger	395	0.95 [0.29-3.11]	0.68 [0.31-1.50]	<b>1.62</b> [1.06-2.49]	2.02 [0.62-6.62]	1.14 [0.52-2.51]	<b>1.84</b> [1.20-2.84]	1.82 [0.56-5.96]	1.49 [0.68-3.28]	<b>2.69</b> [1.75-4.13]
	Car as driver	245	-	-	0.87 [0.67-1.12]	-	-	0.88 [0.68-1.14]	-	-	<b>2.24</b> [1.74-2.89]
	M2W	150	-	0.76 [0.43-1.34]	0.79 [0.53-1.17]	-	1.76 [1.00-3.19]	1.41 [0.96-2.14]	-	-	-
	Bicycle	75	0.69 [0.25-1.90]	1.31 [0.40-4.33]	1.03 [0.57-1.85]	0.82 [0.30-2.26]	1.46 [0.45-4.79]	0.76 [0.42-1.36]	-	-	-
	Pedestrian	155	<b>2.11</b> [1.07-4.15]	<b>2.56</b> [1.40-4.69]	<b>1.72</b> [1.01-2.94]	1.70 [0.87-3.34]	1.52 [0.83-2.80]	0.78 [0.45-1.34]	1.40 [0.71-2.75]	1.06 [0.58-1.94]	0.69 [0.40-1.18]
	Public transport	14	0.57 [0.05-6.29]	1.10 [0.22-5.45]	2.47 [0.28-22.1]	0.31 [0.03-3.42]	0.84 [0.17-4.16]	1.42 [0.06-12.7]	0.86 [0.08-9.48]	1.76 [0.36-8.72]	0.84 [0.05-13.4]

In the case of the young males (Table 2), the incidence ratios (deprived municipalities/other) among the population reveal an excess risk of injuries on a bicycle for individuals over 14 years of age and on foot for individuals under 18 years of age in deprived municipalities. However, M2W injuries among adolescent males were less frequent in deprived municipalities. For young females, there was an excess injury risk in deprived municipalities on foot at all ages, and as a car passenger over 18 years of age. Fewer females were injured in two-wheeler accidents, and the difference between deprived and other municipalities for this mode is not significant.

The incidence ratios among the users of each mode reveal significant injury excess risks in deprived municipalities for male car passengers of under 18 years of age. (It was not the case for 18-24 year-old drivers). Taking into account the number of users of each mode gave another vision of M2W risk in deprived municipalities: there was an excess injury risk among M2W riders from deprived municipalities. The opposite applied when incidences were related to the whole of young population.

In the case of young females (Table 2) as car passengers, the excess risk in deprived municipalities among those of 18 years of age and over increased, while the excess risk for pedestrians disappeared.

The incidence ratios per km travelled for each mode reveal an excess risk for car drivers of both genders in the 18-24 year-old age group from deprived municipalities. The excess risk for M2W users in deprived municipalities was even greater than with the previous indicator among young males of over 18 years of age, increasing from 1.68 to 6.83. However, they had fewer bicycle accidents than young males of the same age from other municipalities. In the case of females of over 18 years of age, there was also an excess risk for drivers from deprived municipalities, and this excess risk was even greater for passengers.

Thus, considering the number of users of each mode reveals that in the case of young males, it is more dangerous to be a car passenger or a M2W user when one lives in a deprived municipality.

If the distances travelled by each mode are considered, the risk is even greater for young male motorists, M2W users and child cyclists of between 10 and 17 years of age from deprived municipalities. Among females, taking this factor into account increases the risk for motorists of between 18 to 24 years of age from deprived municipalities.

## **4 Discussion**

For the first time in France, this study has enabled a comparison of the effects of a contextual socioeconomic indicator (the type of municipality of residence, deprived, or not) on daily travel practices and injury incidences among the population, among the users of each mode and per km of travel.

Customary use of certain modes on weekdays and outside school holidays involves, essentially, but not exclusively, home-to-school trips or occupational trips. This information was supplemented by the kilometres of travel for each mode on the day before the study. Mode use differed considerably between the two types of municipality. The young persons from deprived municipalities used M2Ws and the car (as passengers and drivers) less frequently than those from other municipalities. This result concurs with the findings of an American study by (Van Vliet 1983) which found that children and adolescents from high-income families were more often transported by car. Another study which concentrated exclusively on the home-to-school trips of American students has shown that there are no sociodemographic differences between walking and cycling as opposed to using the car (McMillan et al. 2006).

Use of a particular mode of transport for one's daily trips obviously depends on a large number of factors in addition to the socioeconomic level of one's residential municipality and the ease or difficulty of accessing a car. The status of a young person in relation to the activity (school, work, unemployment), and, especially for those in education, the type of educational establishment

attended (secondary school or further education establishment...), and the population density and centrality of the residential location (Pochet et al. 2010). The use of transport modes is also influenced by the attributes of urban form (McMillan 2007) as well as physical characteristics of the environment or the experience the young person's parents have had of hazards on the road (Fyhri and Hjorthol 2009).

This study is an original contribution to the literature as it considers six different transport modes separately when investigating young persons' accidents, taking account of the number of users of each mode and the distances travelled for each.

In the present study, the M2W users from deprived municipalities are characterized by an excess injury risk, whether the selected denominator is the number of users or the kilometres of travel, which was masked by a lower rate of M2W use, leading to lower risk when using the population rather than riders as the denominator. This result shows the importance of comparing accident data with data on daily travel in order to qualify, clarify or better explain some apparent findings. Likewise, in the case of car passengers, taking account of exposure (proportion of users and the distances covered) reveals a significant excess risk per km of travel among young males and greater excess risk among young females, although car use is lower in deprived municipalities. In the case of car drivers, there is a paradoxical finding, namely a reduced risk in relation to the number of users and an excess risk in relation to the distances travelled, which is partly explained by the lower distances covered in deprived municipalities.

To explain the excess risk per km travelled in deprived municipalities, we can make the hypothesis that risky behaviours are more frequent in deprived areas (Vaez and Laflamme 2005). The behaviours in question can include a failure to wear a helmet or a safety belt, for example. The age of the vehicles may also play a role. Moreover Janke claims that accidents per mile exaggerate the measure of risk in particular for low-mileage groups such as teenagers: people



driving low mileages tend to accumulate much of their mileage on congested city streets with two-way traffic (Janke 1991).

The contextual study does not allow us to measure the proportion of risk that can be attributed to individual socio-economic characteristics, as these are linked to our variable of interest (municipality of residence). These individual variables were not available. Considering modal use at the contextual level nevertheless considerably improves our understanding of the raw differences in traffic injury incidences that exist according to social context. To our knowledge no existing study in this area has applied this method.

As we have no data on the mobility of the young person's at weekends and during school holidays, in the context of this study we have not been able to examine holiday periods, and have targeted those killed or injured in accidents that occurred between Monday and Friday and outside school holidays. However, in France, social inequalities have more effect on long distance travel (summer holidays) than local travel, on weekend travel than week-day travel, and on leisure travel than home-to-school travel. The degree of choice and the constraints associated with the young peoples' place of study, which vary according to social class, influence amount of travel and the transport modes used during the week (Paulo 2006). The difference between deprived and other municipalities would perhaps be greater if we had been able to study all the days in the year. It would therefore be interesting to conduct a study of this type for weekends and school holidays.

The Rhône Registry only contains accidents that occurred in the *Département*. It is possible that the residents of the more advantaged municipalities, a lower proportion of whom reside within the Lyon conurbation and who travel greater distances are more often injured outside the *Département*, which could lead to an overestimation of the risk ratio between deprived municipalities and the others. However, we know that most accidents occur near people's homes. In the Registry, in 2005-2006, 85.6% of the 10-24 year-old casualties of accidents which occurred in the Rhône *Département* were residents of the Rhône *Département* too.

By considering only the nature of the municipality (with or without a ZUS), we have, because of the limitation of the data, “diluted” our analysis by classifying individuals who live in a municipality with a ZUS but not in the ZUS itself as exposed. Nevertheless, our indicator “municipality with a ZUS” seems to be valid, as the presence of a ZUS is strongly linked to the socioeconomic level of the municipality, as we have shown. This indicator is available for the whole of France.

The coexistence of the Registry and the household travel survey has made it possible to compare risk exposure data with data on the road traffic injuries that occurred in the same period and in the same area, which has revealed that journeys made by car and two wheelers are more dangerous for young persons who live in deprived municipalities.

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