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► **To cite this version:**

Alice Billot-Grasset, Emmanuelle Amoros, Martine Hours. A Cyclist Accidents Typology: survey methodology using a medical registry. TRB 2014 - Transportation Research Board 93rd Annual Meeting, Jan 2014, WASHINGTON, United States. 15 p. hal-01073620v2

HAL Id: hal-01073620

<https://hal.science/hal-01073620v2>

Submitted on 21 Feb 2018

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BILLOT-GRASSET, Alice, AMOROS, Emmanuelle, HOURS, Martine, 2014, A Cyclist Accidents Typology: survey methodology using a medical registry, TRB : Conference proceedings, Transportation Research Board TRB 93rd Annual Meeting, WASHINGTON, ETATS-UNIS, 2014-01-12, 15 p

A Cyclist Accidents Typology: survey methodology using a medical registry.

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Keywords: cyclist, accident circumstances, injuries, survey method, medical registry

Submission date: 30/07/2013

Number of words: 5867

Number of figures: 1

Number of tables: 2

ABSTRACT

Bicycle is promoted in many major cities as an healthy and eco-friendly transportation mode. However, cycling is risky and safety issues concern a few thousands of victims every year. In France we estimate an annual incidence rate of 70 road injuries per 100,000 inhabitants. Most of the existing studies focus on particular accident factors and are based on police registry. However, police data are biased and non-representative of cyclist crash circumstances. In this work, we propose to improve knowledge of accident circumstances by surveying 3337 cyclists injured in 2009-2011 and identified from a road trauma registry around Lyon in France. The main objective is to build a cycling accident configuration typology from detailed collisions or falls circumstances. To do so, we built up a questionnaire and tested it. The pilot survey response rate was 18%. Respondents were older, more often women, having more serious accidents, more often in urban areas. We observed that 1/3 accident occurred on a non-business trip, 1/3 on a commuting trip and 1/4 while practicing a cycling sport. A third party was involved in 45% of crashes whereas 37% declared that an obstacle, a loss of control (19%) or/and a mechanical failure (13%) was one of the crash factors. Learning from the pilot stage, the questionnaire design improvement is detailed, enabling a reduction of the selection bias. The final response rate reached 43%. Overall, the survey is successful and improves knowledge in comparison with existing studies.

1 INTRODUCTION

2 Bicycle is promoted as an urban transportation mode in many cities around the world because of
3 health benefits at the microlevel addressing problems linked to obesity and diabetes diseases and at the
4 macrolevel meaning air quality improvement. However, cycling is risky and in France we estimate
5 about 70 road injuries per 100,000 inhabitants per year [1]. Because of medical care costs, policy
6 makers may have a major interest in preventing major and minor accidents [2]. Previous studies has
7 shown that most of the existing studies are based on data that lack representativeness [3-6]. In this
8 work, we propose a study of cyclist accidents from the “Rhône Road Trauma Registry”. This medical
9 database includes all outpatients and hospitalized patients, victims of road accident in the Rhône, a
10 French department. It is located around Lyon, a major urbanized area. To collect detailed accident
11 circumstances, questionnaires have been sent by mail to 3337 cyclists injured between 2009 and 2011.
12 This survey is the first one of this magnitude in France and one of the few in the world using injury
13 data from hospitals [7-11].

14 In this paper, we describe population selection, questionnaire construction, pre-testing and pilot survey
15 results that allow improving the final response rate as well as the relevance of this work. Finally, we
16 identify key questionnaire improvements and we share methodological aspects on accident survey
17 design.

18 In France, bicycle safety literature has estimated the overall accident risk [12] and the risk exposure
19 [13]. Both of them have been compared to other transport modes. Accident mechanisms for single
20 bicycle crashes and collisions with a third party have mainly been studied from police records [14].
21 Nevertheless, police data are not appropriate to study cycling safety because of a well-known under-
22 reporting bias. This bias is mainly about road user type and whether another road user is involved or
23 not in the accident [5]. For instance, the proportion of injuries related to collisions and bicycle-only
24 crashes have been identified from the Rhône medical registry; respectively 30% and 70% [15].
25 Moreover, in some countries, the number of bicycle accidents reported in medical databases or
26 through survey exceeds the police reported number by nearly two times [16] and up to nine times in
27 the department studied in this research [15]. Additionally to selection bias on road user type; police
28 data is biased on injuries severity, road type [17]. As a result, most of the existing studies, as useful
29 and informative they are, cannot replace a survey addressed to cyclists and aiming to identify accident
30 mechanisms. Indeed, using a medical registry to identify victims is an asset. With respect to the Rhône
31 road trauma registry, a coverage rate of 80% was estimated for all injured cyclists. [15].

32 These data limitations were underlined when some studies focused on single crash accident
33 circumstances as they were missing from most of the sources. Besides, single bicycle accidents remain
34 understudied in urban areas, in the literature they represent from 47% up to 81% of crashes depending
35 on the country and its road accident definitions [7-9]. The common definition of a one-vehicle
36 accident is a loss of control. But it can be divided into three main cases: an obstacle avoidance, an
37 avoidance of another road user and a simple loss of control [3, 18, 19]. That also explains why, from
38 our point of view, single-crash and collisions circumstances have to be analyzed all together. In
39 France, some recent work gives the accident distribution of 51 urban cyclist accident scenarios based
40 on 650 police records from 2001 to 2007 [14]. However, only 9 scenarios have been especially created
41 for cyclist crashes and all are mixing collisions and falls. Some more typologies are available in
42 Europe [20] and in other countries around the world [21] but their relevance is limited because they
43 also focus on collision crashes. To summarize, there is an important need for data collection on
44 cyclist’s accidents circumstances looking at both collisions and single-crashes, linking it with injuries

1 to address accident and injury prevention. So far, there is no data allowing us to analyze additionally:
2 accident circumstances, type of accident and type of injury. The survey method explained in the
3 following section will bridge the gap and enable the construction of a cyclist accident typology.

4 **MATERIAL AND METHOD**

6 **Data selection**

7 This study aims to better understand how people get injured because of bicycle accidents after a
8 collision or a fall. Our dual objective is to improve primary prevention meaning accident avoidance
9 and secondary prevention which is injury minimization. To be efficient, we must set up a typology of
10 cyclist accidents as representative as possible. In an ideal world, we could survey a broader random
11 sample of the national population. However bicycle modal share represents only 3% of French usage
12 [22]. Then, for an optimistic sample size of cyclist, we would have to contact a very large number of
13 people, without knowing whether they have been injured in the previous years.. So we would have to
14 include people injured many years ago and accept an important memory bias. Therefore, it is more
15 realistic to use existing data. In France, we have 3 main sources and methodology to study cyclist
16 accidents as follows.

17 *Detailed accident study & prototypal scenarios*

18 Since 1992, one research unit at *the French Institute of Science and Technology for Transport,*
19 *development and networks* (IFSTTAR) is in charge of detailed accident study. The data has a thousand
20 of vehicle crashes and aims to improve knowledge of accident mechanisms. To generate new research
21 hypothesis, they collect accident reconstitution, description and detailed analysis. Some researchers
22 construct accident prototypal scenarios from this data [23]. This method is of interest for our topic as it
23 determined sufficient and necessary elements in the incident chain leading up to a crash. In addition,
24 the chronology is decomposed to understand how a driving situation is interrupted by an accident
25 situation, leading to an emergency situation that precedes a collision and its consequences. This
26 method is a combination of a system approach (pilot-vehicle-infrastructure) and systems modeling
27 (sequential-kinematic-operator). However, they collected only around 30 cyclist accidents in 20 years
28 and almost only collisions. Obviously, even if representativeness is not necessary to understand
29 intrinsic crashes mechanism, it is required for epidemiology studies addressing prevention.

30 *Police data & bulletin of road traffic injuries accidents.*

31 Since the 1950's, French police services have to complete a form for each accident with at least one
32 injured person, named: "analysis bulletin of road traffic injury accidents". This data remains the main
33 source for most of the accident studies and much research has been conducted thanks to it even if there
34 is under-reporting and significant bias compared to medical sources [17]. Indeed, in the Rhône
35 department, the police data registered around 150 bicycle accidents per year when, at the same time
36 and on the same territory, the medical data registered around 1300 people injured while cycling. The
37 differences between the two databases have been explained [6]. To be more specific, under-reporting
38 is mainly related to injury severity, meaning slightly injured road user are 0,35 times less registered
39 than severely injured.

1 *Rhône Road Trauma Registry*

2 The Epidemiological Research and Surveillance Unit in Transport, Occupation and Environment
3 (UMRESTTE) is one research unit of IFSTTAR in charge since 1995 of “The road trauma registry”.
4 This registry combines inpatients and outpatients from 260’s medical services (public or private) in the
5 Rhône area. This data contains several victims’ characteristics such as age, gender, date of birth, postal
6 address and type and severity of the lesions. In addition, there are a few accident indications such as
7 date, place, type of road user, type of antagonist and some hints of crash circumstances. Using this
8 registry, there are two small limitations biases: the injuries severity and the distance between the
9 accident location and the hospital. Nevertheless, to extrapolate result to the French territory some
10 statistical techniques tacking into account biases have already been developed and are operational
11 [24].

12 *Target population & survey method justification*

13 From the Rhône Road Trauma Registry, we selected people over 10 years old on the accident day.
14 This choice has been made for two main reasons. Firstly, to avoid young cyclist crashes corresponding
15 to learners falls and traditionally related to 0-14 years old age group that have already been studied
16 [25]. Secondly, to include high school students from 11 years old because some of them commute to
17 school. We excluded deceased people and passengers to collect pilot point of view. Using the most
18 recent years, we aimed to reduce invalid address and memory bias. Overall, we had 3337 subjects. To
19 contact them, we had two options: send them letters or search for phone numbers.

20 A test has been conducted to estimate the time required to find and contact all people for a phone
21 survey. It takes only one minute to search a phone number per address. But, it takes 55 hours to search
22 3337 times. Also, we found that one address out of two was really associated with a number, then to
23 find the 1668 and reach each household, 150 and 200 hours is required with an average number of 5
24 calls of one minute duration. Postulating an average response rate of 50%, we could obtain 800
25 respondents interviewed during 15 minutes on average, hence another 200 hours is required. The total
26 time cost would be from 400 to 450 hours meaning 12 full weeks for one person.

27 The second option is to send a postal survey. It takes one day to print 3337 letters, questionnaires and
28 pre-addressed envelopes. Then, it takes around one hour to prepare 250 envelopes. In one week the
29 survey is sent. The response rate might be lower but, with a recall letter the response rate is
30 improvable. In addition, we can identify differences between target population and sample in terms of
31 age, gender, type of accident and injury severity. So far, there is no good reason to invest 10 times
32 more in a phone survey. From another point of view, we can lose respondents because some people
33 have difficulties reading and writing. To make sure that this may not happen often, we suggest in the
34 first part of the questionnaire that people can participate through phone or using the internet.

35 **Interviews to understand risk of accident definition**

36 A very important step is questionnaire design, especially for a postal survey. To do so we first studied
37 from the existing literature several questionnaires constructed to collect data on cycling accidents.
38 However, none of them had our objective to construct a typology. We decided to conduct interviews
39 with a mind of combining researchers’ and stakeholders’ viewpoints about cyclist safety. Exploratory
40 talks aimed to identify a pattern in risky situations and the perception of a safe trip. We determined
41 that cycling instructors were the relevant target group because they can inform us about their own

1 practice assuming they are experienced and firmly convinced cyclist. Moreover they can inform us
2 about the less skilled cyclists. The ultimate goal of this research is prevention and instructors will have
3 to relay safety related findings; hence, it will be easier to convince them knowing their point of view.
4 There are 35 “cycling schools” in the French cycling community network and we interviewed 14
5 instructors working in different cities as volunteers or employees for between one month and 10 years.
6 The interview guide questioned them about accidents, risks and tips to avoid crashes or collisions. For
7 instance, we asked them: ‘what is an accident?’; ‘which are the common ones?’; ‘which are the serious
8 ones?’; ‘Does each type of cyclist have the same risk of accident? (meaning: child, adolescent, adult,
9 men, women...)’; ‘what good advice can be given to learners for their safety?’. To be more specific,
10 we used interviews for questionnaire design but there is enough material to be analyzed and compared
11 later on with statistical results.

12 **Pilot Survey**

13 *Questionnaire creation: pre-test & target population*

14 The first version of the questionnaire was distributed in February 2012 to cyclists from organizations,
15 as well as colleagues, friends and family. Our objective was to test each question and to determine a
16 response rate. Using comments, an improved version has been submitted to the French Data Protection
17 Authority (CNIL), which requires it for legal purposes. This second version was addressed to cyclists
18 injured in 2007. A total of 885 questionnaires were mail posted with an introductory letter and a pre-
19 addressed envelope to conduct a pilot survey. The questionnaire format was an A4 two-side printed
20 and stapled with the letter to identify respondents.

21 *Pilot survey, Response Rate and possible bias*

22 The response rate was 18% (N=103); there were 325 invalid addresses and 457 non-responses.
23 Analyses were conducted on 95 people because 8 forms were non-retrievable. Most responses arrived
24 one week later and some up to 3 months later. Results showed differences between respondents and
25 non-respondents. Participants were older than non-respondents, 75% are over 35 years old versus
26 35.4%. They are more often women (37% vs. 23%) and mainly cycling on urban roads (78% vs. 60%).
27 Respondents had been involved in collisions more often than others (30% vs. 22%) and had more
28 serious injuries (55% minor injury vs. 67%). Age group differences are explainable by residential
29 mobility since the accident in 2007: the youngest (10-15) have a larger probability to be still living
30 with their parents while the oldest (over 35) often own their residence. Therefore addresses probably
31 didn’t change and then both groups have a higher response probability. At the same time, young adults
32 move to individual places when they start to study or to work (20-24) while their elders have to move
33 to find housing with more rooms to raise children (30-34).

34 To sum up, the response rate must be improved and the final survey must reduce some bias even if
35 analyses can be performed to adjust non-response bias, as in a previous work based on mail survey
36 [26]. Typically, non-respondents are younger and more often men in many mail surveys. In addition, a
37 classic bias is on the accident type because people involved in a collision are more likely to recall it
38 and generally feel more concerned by road safety surveys. Therefore injury severity bias is consistent
39 because collision generally involves more serious injuries. Moreover, the ridden surface and type of
40 practice are both linked with injuries severity. For instance, utilitarian trips are on-road practice then
41 cyclists have a higher probability to collide with motorized vehicle, thus to be seriously injured.
42 People practicing off-road sport have a higher probability to collide with objects or to lose control.

1 *Data collection and data Entry.*

2 For the pilot survey data entry we chose an online software named LimeSurvey. After creating the
3 questionnaire, we used the input mask to fill out our data. During this step, some technical problems
4 were identified and solved. After all, we realized that we can afford to promote internet participation
5 for the final survey; this could raise the response rate. With online participation we were able to create
6 a unique link for each person in the sample in order to link the survey data with the medical registry as
7 we planned to do with the paper form. On average, both questionnaire formats could be completed in
8 20 minutes.

9 *Pilot survey main results*

10 Most of the accidents occurred in cities (57%), during daylight (87%) and away from intersections
11 (67%), as we can observe on table 1. In one case out of two the main purpose for cycling was
12 utilitarian; some were commuting (25%) and other people were visiting friends, going shopping, or to
13 a leisure activity (32%). Another quarter (24%) were practicing sport such as road cycling or mountain
14 biking while 18% were on a leisure ride. Less than half of the accidents involved a third party (45%).
15 Compared to obstacle (37%), slipping on the ridden surface (19%) and a mechanical failure (14%) are
16 other common accidents factor. One person out of two did not have the time to do anything to avoid
17 the accident (52%). Lastly, around half of the victims (49%) required medical assistance on site.
18 Police came in 13% of all cases which confirms under-reporting evaluated between medical and police
19 data as stated above. Regarding secondary safety, almost half of our sample were wearing helmets
20 (47%). This proportion reflects a socially acceptable response bias because it is much more than what
21 we can observe in France; hence we must modify this question. Other conspicuity garments such as
22 fluo or retro-reflective vests or legs bands had largely not been worn (respectively 97% and 96%)
23 whereas two cyclists out of ten were wearing light or bright colored cloth.

24 **LEARNING FROM THE PILOT STAGE: QUESTIONNAIRE DESIGN IMPROVEMENT**

25 **Increasing response rate.**

26 The main conclusion from the pilot survey was the necessity to improve the response rate. To do so
27 we first chose to build up a shorter questionnaire by selecting the most meaningful questions and
28 items. We removed sensitive questions, such as ‘did you run the red lights or the stop sign?’
29 disappeared from the last version because even if they did it, people answered ‘no’. Most of the
30 questions have been reorganized to reduce average time of completion. For instance, as shown in table
31 2, items to answer the question ‘How was the weather at the time of the accident?’ have been
32 simplified. Another example of removed items is the ‘business trip’ for the question ‘your accident
33 took place while cycling to...’ because it is an unlikely situation (1%). In the same vein, we added an
34 item ‘other, please specify’ to each question to collect rare events. We want to underline here that the
35 “I don’t know” item is always offered to allow people to choose this answer for sensitive questions
36 just as much for amnesia because of a brain trauma. Indeed, 2.6% of the studied population have
37 moderate to severe injuries on the head using the MAIS scale (Maximum Abbreviated Injury Scale on
38 a 6 level scale, from 1 “minor” to 6 “beyond treatment” [27]). Another way to ask sensitive questions
39 is to underline behavior normality. For instance, the final version of the helmet question is therefore:
40 ‘Were you wearing one of the following NON COMPULSORY pieces of equipment?’
41 Thirdly, we reorganized every section from the most common question to the least common one
42 because some people cycling for sport felt that their experience was not related to our pilot survey
43 while reading the first page therefore, they were mostly non-respondents. To do so, questions

TABLE 1 Main results from the pilot survey

	N=95 %	
Crash area		
City	54	56.8
Suburb	20	21.1
Countryside	19	20.0
Accident		
By day	83	87.4
At night	10	10.5
In between	2	2.1
Type of trip:		
- visiting friends, going shopping, to the cinema, to a leisure activity...	30	31.6
- commuting to work or school/university	24	25.3
- practicing sport (road or mountain biking...)	23	24.2
- taking a leisure ride (with family or friends)	17	17.9
- business trip	1	1.1
Crash involving a third part (yes)	43	45.3
Not applicable	5	5.3
Crash because of a slip on the road (yes)	17	17.9
Unknown	2	2.1
Had time to do an action to avoid accident (yes)	41	43.2
Unknown	5	5.3
Crash because of mechanical failure (yes)	13	13.7
Crash because of obstacle (yes)	35	36.8
Medical assistance (yes)	46	48.4
Police attendance (yes)	12	12.6
Wearing a helmet (yes)	45	47.4
Wearing a fluo and retro-reflective vest (yes)	3	3.2
Wearing a fluo and retro-reflective bands (yes)	4	4.2
Light or brightly colored clothing (yes)	19	20.0

TABLE 2 Examples of questionnaire improvement

	N=95	%	N=1078	%
How was the weather at the time of the accident? (Q24 in the pilot study)				
Light rain	4	4.2		
Heavy rain	0	0		
Snow or hailstorm	1	1		
Fog	0	0		
Wind or storm	1	1		
Blinding sun	31	32.6		
I do not know	11	11.6		
Other	47	49.5		
How was the weather at the time of the accident? (Q9 in the final study)				
Quite normal, fair weather			837	77.1
Cloudy			96	8.8
Rainy			69	6.4
I do not know			29	2.7
Other			41	3.8
Unknown			6	0.6
Were you at an intersection? (Q25 in the pilot study)				
Yes	21	22.1		
No	64	67.3		
Unknown	10	10.5		
Were you at an intersection? (Q16 in the final study)				
Yes			768	70.8
No			276	25.4
Unknown			34	3.8

1 concerning each person in the target population have been moved such as the third question in the
2 final form ‘where did your accident happen?’ is before ‘where was the other person coming from in
3 relation to you?’; this question clearly concern cyclist who collided. Table 2 shows that question
4 ordering is not influencing only overall response rate but also the proportion of ‘unknown’ answers.
5 Between the pilot study and the final study this proportion has been divided by 3 when we asked
6 ‘Were you at an intersection?’. Following the same approach, items were classified from the most
7 common answer to the least common one. For example, items for “how was the road surface?” were
8 ordered according to occurrences in the pilot survey: dry, graveled, wet, others. Finally, phone calls
9 and e-mails that we received demonstrated that the introductory letter provided efficient information
10 about our research and the way to participate.

11 12 **Questionnaire description**

13 The questionnaire format is a double-sided, folded A3 sheet presented in figure 1. Previous studies and
14 our team’s professional experience demonstrated preferences for this standardized size. A personal
15 introductory letter went together with the questionnaire to explain our research. The date of the
16 accident was specified on it to make sure that people would complete the form about the accident
17 registered in our medical database. In addition an ID number was attributed to each patient and allows
18 us to link the questionnaire with the registry.

19 The questionnaire aims to understand accident’s circumstances to construct a typology of cyclist
20 collisions and falls. It is mainly about accident factors but also it collects cyclist characteristics and
21 habits as well as trip characteristics. It has been split into seven categories: identification; context of
22 the accident; meteorological conditions and road surface; falls and collisions; cyclist and bicycle
23 equipment; accident’s consequences and lastly accident story which that can also be used as a
24 comment space.

25 The opening part has two objectives. First, identify people thanks to the date of birth and ID number in
26 order to link each questionnaire with the registry. Second, ask internet and phone details to contact
27 people and increase participation. The following category aims at locating the accident in terms of
28 place and time. In this part we also ask the trip purpose and the type of traffic environment to get a
29 frame of mind setting. In third part, we focus on meteorological accident factors such as weather, light,
30 topology and trajectory. There are two main hypotheses to be tested here: accidents related to a lack of
31 visibility for detecting any moving or stationary obstacle and those associated with poor road surface
32 maintenance.

33 The next category aims at identifying the type of accident: fall or collision with or without the
34 avoidance of an object or another road user. We ask in questions 16 to 18 for cyclist trajectory and in
35 question 19 for the involvement of a third party or the involvement of an obstacle. The pilot survey
36 demonstrated that cyclists do not make any distinction between an object and a person on their path.
37 As a result, those two questions have been combined in the final questionnaire and respondents were
38 asked to specify if they avoided or hit any object or road user in the list. In the case of a collision, we
39 also asked them if they got hit by another road user. If the accident was related to another person, then
40 we also ask for the trajectory of this person in relation with the cyclist. By adopting the cyclist’s point
41 of view we intend to detect accident factors in the pre-crash situation, in the crash situation and in the
42 emergency manoeuvre if any. Assuming that equipment has a protective action in some cases and is
43 contributing accident factor in some others; the fifth part is dedicated to bike gear and maintenance as
44 well as cyclist use of conspicuity device or protective equipment. Part six asks about crash
45 consequences to identify causes of injuries and severity by selecting in the list an object by which they
46 got injured. In addition, respondents had to specify if any emergency services came on site. To
47 evaluate the proportion of people giving up with cycling after a crash, we ask them if they are still

1 cycling. We also want to test the hypothesis that a lack of experience contributes to certain accident
2 type. For instance, occasional cyclist who are mainly quasi exclusive car drivers; may have a higher
3 probability to fall on a dedicated infrastructure during a Sunday leisure ride than experimented cyclists
4 able to anticipate with obstacles such as kerbsides, gravels, holes or bumps. At the opposite, too much
5 confidence may contribute to increase risk taking for experimented cyclists and contribute to different
6 type of accident such as a collision with a turning car while overtaking a line of vehicle. In the final
7 part of the questionnaire the cyclist is asked to write in details about how the accident occurred.

9 **Survey Response Rate**

10 The final survey response rate is 43% (1 095 questionnaires). There were 794 invalid addresses and
11 1455 non-responses. Most of responses arrived during the 2 first weeks. We consider the survey as
12 successful given its nature: a postal survey with only one remind letter and a questionnaire sent
13 together. Results showed differences between respondents and non-respondents. As in the pilot study,
14 participants were older (62.5% are over 35 years old vs. 33%), more often women (27% vs. 19%),
15 more often cycling on urban roads (65% vs. 54%). Respondents have been more often than others
16 involved in collisions (30% vs. 22%). Age, gender and type of road bias are reduced compared to the
17 pilot survey. We observe that the proportion of collisions is the same as in the pilot survey.

18 **DISCUSSION**

19 Learning from the pilot survey, the final response rate reached 43%. Using a mail survey, we can say
20 that it has been successful [28, 29]. The final sample exceeds 1000 respondents and should improve
21 knowledge because accident factor measurement can be considered as representative as possible of
22 injured cyclist crashes. As we explained in the above, the Rhône road trauma registry is slightly biased
23 on injury severity and distance to the hospital. Furthermore, it contains inpatients and outpatients;
24 hence, we may only miss very slightly injured people.

25 Thanks to the questionnaires design improvement and the use of the most recent years available in the
26 road trauma registry we also obtained bias reduction between respondents and non-respondents. A
27 critical remark would be about the biggest bias which is age related. Therefore, using classification
28 methods we need to determine if age is a constructive or an explanatory variable in the typology.
29 Gender bias is also important but classic for this type of survey. Nevertheless we must pay specific
30 attention to gender effect because an estimate gives that women have 2.43 times more chances to have
31 an accident than men while cycling [13]. At this stage we can only suppose that men are cycling for
32 sport more than women even if they take more risks and ride faster; they may have more experience in
33 cycling situations. For instance, we can suppose that a person cycling off-road learns and capitalizes
34 knowledge that might be transferable to urban practice while avoiding an obstacle. In addition, most of
35 commuters in urban areas are man and therefore we can suppose that they also may have more
36 knowledge as a group on risky situations and black spots for the majority of their daily trips. At the
37 opposite, women are mainly cycling on utilitarian trips in the city but not only to commute from home
38 to work. They also shop, pick up children at school or kinder garden, take care of administrative
39 formalities. Moreover, they are rarely practicing bike as a sport since childhood. As a result, they may
40 have, as a group, globally less knowledge and less experience coming from the diversity of ridden
41 surfaces. Then they may have more probability to crash because of an obstacle or a loss of control.
42 Moreover, women respect road rules because of a different internalization of safety rules by
43 comparison with men [30]. Basically, to feel in security while interacting with other people, they
44 respect rules. But, doing so, they will more hesitate in an urgent situation.

1. What is your date of birth? Date of birth (DD/MM/YYYY) : ____/____/____

2. How would you like to complete the questionnaire?
 Via phone, please indicate your number and send us back the blank questionnaire : ____/____/____/____/____/____
 Via Internet, please indicate your e-mail and send us back the blank questionnaire : _____@_____
 Via postal, please complete the following questionnaire and return it using the preaddressed envelope

Context of your accident

3. Where did your accident happen?
 This accident took place in : City Suburb I do not know
 Countryside
 Township : _____ Zip code : ____/____/____/____

If you can recall the exact location, please indicate Street/Route/Place _____

4. What was the time of the accident? _____ : _____ I do not know

5. Were you carrying any passengers?
 No Yes I do not know

If yes, were they A child An adolescent An adult } **Where was he sitting?**
 On a specifically designed seat
 On the carrier
 On the handlebar

6. Your accident took place while cycling to ...? Please, indicate only one answer
 Visit friends, go shopping, the cinema, a leisure activity, ... I do not know
 Commute from or to work/school/university
 Practice sport (road cycling, mountain biking, BMX,...)
 Take a leisure ride (by yourself, with family or friends)
 Other, please specify : _____

7. Did this accident take place in a motorized traffic area?
 No Yes I do not know

If yes, was it on a Road, that was shared by all type of vehicles
 «Cycle track» : cycle path physically separated from the road
 «Cycle lane » : marked by a white coat of paint on the road
 «Contraflow cycling » : contraflow where bike are allowed to circulate
 Pedestrian passage
 Bus lane
 Tram way
 Other, please specify : _____ I do not know

If not, was it on a Mountain bike path (forest, mountain, countryside, ...)
 Sport ground (skating park, cross, BMX ...)
 « Via Verte » : track where pedestrian, horse riders and cyclist are allow
 Sidewalk
 Track in a park
 Other, please specify : _____ I do not know

8. Did the accident take place on a familiar path?
 No Yes I do not know

Meteorology and road surface

9. How was the weather at the time of the accident?
 Quite normal, fair weather Cloudy Rainy I do not know
 Other, please specify : _____

10. Was it:
 Day Night In between I do not know

11. Which lighting did you turn on?
 Front lighting Rear lighting None I do not know

12. Were you travelling on a flat surface, downhill or uphill?
 Flat Downhill Uphill I do not know
 Other, please specify : _____

13. Was the road straight-line or curve?
 Straight-line Left turn Right turn I do not know
 Other, please specify : _____

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14. How was the road surface?
 Dry Wet I do not know
 Graveled Slippery (oil, dead leaves, snow, ice, etc.)
 Other, please specify : _____

15. Did you slip?
 No Yes I do not know

If yes, On the surface i was riding
 On the way up or down the sidewalk
 Other, please specify : _____

Type of accident

16. Were you at an intersection?
 No Yes I do not know

If yes, was it A junction with traffic light
 A junction with a stop sign
 A junction with a yield sign
 A priority-to-the-right
 A roundabout
 Other, please specify : _____

Should you have had the priority?
 No Yes I do not know

17. Were you heading straight on?
 No Yes I do not know

If yes, I was heading straight on with the flowing traffic
 I was heading straight on travelling against traffic (wrong way)
 Other, please specify : _____

If no, I was turning left
 I was turning right
 Other, please specify : _____

18. Were you overtaking?
 No Yes, I was passing on the left I do not know
 Yes, I was passing on the right

19. Did the accident have anything to do with a person/car/vehicle or with an obstacle?
 No Yes I do not know

If the accident involved a person or vehicle, was it:		I avoided it	I hit it	I got hit
1.	<input type="checkbox"/> A pedestrian	1. <input type="checkbox"/>	1. <input type="checkbox"/>	1. <input type="checkbox"/>
2.	<input type="checkbox"/> Another cyclist	2. <input type="checkbox"/>	2. <input type="checkbox"/>	2. <input type="checkbox"/>
3.	<input type="checkbox"/> A two-wheel vehicle (scooter, motorbike, ...)	3. <input type="checkbox"/>	3. <input type="checkbox"/>	3. <input type="checkbox"/>
4.	<input type="checkbox"/> A car (light vehicle)	4. <input type="checkbox"/>	4. <input type="checkbox"/>	4. <input type="checkbox"/>
5.	<input type="checkbox"/> Other, please specify : _____	5. <input type="checkbox"/>	5. <input type="checkbox"/>	5. <input type="checkbox"/>

If the accident involved an obstacle, was it:		1.	2.	3.	4.	5.	6.	7.	8.
1.	<input type="checkbox"/> A kerbside	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	<input type="checkbox"/> A tramway or train rail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	<input type="checkbox"/> A car door	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	<input type="checkbox"/> A parked vehicle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	<input type="checkbox"/> A pole (short post, pile, pillar...)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.	<input type="checkbox"/> A hole or a bump (paving stone, pool of water...)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.	<input type="checkbox"/> An object, road debris (hubcap, glass, branch...)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.	<input type="checkbox"/> Other, please specify : _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

20. What direction was the person/vehicle moving in with relation to you?
 Not applicable
 I do not know

It was heading straight on with the flowing traffic
 It was heading straight on travelling the wrong way
 It was turning : to its left to its right

It was crossing my course / my path
 It was reversing on my course / my path
 We were side by side
 Other, please specify : _____

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21. Where was the other person/car/vehicle coming in relation to you? Not applicable I do not know

It was coming towards me It was coming from behind, overtaking me : on the left on the right It came from : my left my right

22. Did you see the obstacle or the other person/car/vehicle? Not applicable I do not know

No Yes, in advance Yes, at the last minute

23. Did anything prevent you from seeing the obstacle or the other person/car/vehicle? Not applicable I do not know

No Yes

If yes, was it A parked car (or a parked vehicle) Another cyclist A moving car (or a travelling vehicle) A tree or a hedge The car (or vehicle) was coming from behind A turn (a curve on the left or on the right) Other, please specify : _____

If no, My attention was distracted by something else (advertisement, music, mobile phone, landscape,...) The other person did not see me Other, please specify : _____

24. Did your bike have a mechanical failure? I do not know

No Yes It caused the accident : It contributed to the accident but didn't cause it:

If yes, the fault was with :

1. <input type="checkbox"/> A brake	1. <input type="checkbox"/>	1. <input type="checkbox"/>
2. <input type="checkbox"/> A foot braces or clipless pedal	2. <input type="checkbox"/>	2. <input type="checkbox"/>
3. <input type="checkbox"/> The chain or the chain ring (gear not locked, chain goes off, ...)	3. <input type="checkbox"/>	3. <input type="checkbox"/>
4. <input type="checkbox"/> The fork or the handlebars	4. <input type="checkbox"/>	4. <input type="checkbox"/>
5. <input type="checkbox"/> A wheel or a tire (detachment, poor inflation, flat tire...)	5. <input type="checkbox"/>	5. <input type="checkbox"/>
6. <input type="checkbox"/> Something trapped in wheel spokes, please specify : _____	6. <input type="checkbox"/>	6. <input type="checkbox"/>
7. <input type="checkbox"/> Other, please specify : _____	7. <input type="checkbox"/>	7. <input type="checkbox"/>

25. How did you try to avoid the accident? I do not know

Nothing, I didn't have the time I swerved to the left or the right I braked I tried to warn others (bell, scream,...) Other, please specify : _____

26. How fast were you riding? I do not know Very fast

The accident occurred while getting on or off my bike Slowly Quite fast Fast Other, please specify : _____

27. Were both of your hands on the handlebars? I do not know

No Yes

If no, please specify (mobile phone, music, bag,...) : _____

28. Had you been drinking alcohol? I do not know

No Some Moderately Heavily

Equipment

29. For each piece of equipment, specify the condition:

	In good working order	Malfunction or not working at all	Wasn't on the bike	I do not know
1. <input type="checkbox"/> Bell	1. <input type="checkbox"/>	1. <input type="checkbox"/>	1. <input type="checkbox"/>	1. <input type="checkbox"/>
2. <input type="checkbox"/> Front lighting	2. <input type="checkbox"/>	2. <input type="checkbox"/>	2. <input type="checkbox"/>	2. <input type="checkbox"/>
3. <input type="checkbox"/> Rear lighting	3. <input type="checkbox"/>	3. <input type="checkbox"/>	3. <input type="checkbox"/>	3. <input type="checkbox"/>
4. <input type="checkbox"/> Front brake	4. <input type="checkbox"/>	4. <input type="checkbox"/>	4. <input type="checkbox"/>	4. <input type="checkbox"/>
5. <input type="checkbox"/> Rear brake	5. <input type="checkbox"/>	5. <input type="checkbox"/>	5. <input type="checkbox"/>	5. <input type="checkbox"/>

30. Did you have cargo? I do not know

No Yes

If yes, I was wearing : A backpack on ONE of my shoulders A bag or something in a box attached to the bike A backpack on BOTH of my shoulders A bag or something in a front pannier A shoulder bag A bag or something on the luggage carrier Other, please specify : _____ A bag or something hanging from the handlebars

31. Were you wearing one of the following NON compulsory pieces of equipment? I do not know

Fluorescent or retroreflective leg stripes A helmet Light or brightly colored clothing Fluorescent and retroreflective vest No, none Other, please specify : _____

32. Did the accident occur with your own bike? I do not know

Yes No, with a Vélo'v (bike-sharing) No, with another bike

Consequences

33. What was the object that caused your injury? I do not know

The ground A kerbside Your bike A building or a wall... A moving car (or a vehicle) A tree, a pole (short post, pile, pillar...) A car door Other, please specify : _____

34. Did you require medical or police assistance? Did they come on site? I do not know

Fire brigade Yes No I do not know
 Emergency medical assistance service Yes No I do not know
 Police or gendarmerie Yes No I do not know

35. During the year that your accident occurred, were you using :

	Never	Few times a year	1 to 3 times a month	1 to 3 times a week	Almost every day
1. <input type="checkbox"/> A bike	1. <input type="checkbox"/>	1. <input type="checkbox"/>	1. <input type="checkbox"/>	1. <input type="checkbox"/>	1. <input type="checkbox"/>
2. <input type="checkbox"/> A car	2. <input type="checkbox"/>	2. <input type="checkbox"/>	2. <input type="checkbox"/>	2. <input type="checkbox"/>	2. <input type="checkbox"/>
3. <input type="checkbox"/> Public transport system	3. <input type="checkbox"/>	3. <input type="checkbox"/>	3. <input type="checkbox"/>	3. <input type="checkbox"/>	3. <input type="checkbox"/>

36. Since this accident, have you been more reluctant to cycle? No Yes I do not know

37. Nowadays, do you still ride a bike? No Yes

38. In the past 5 years, how many bike accident or fall do you remember? (excluding this one) _____

39. Would you like to receive our survey results in 2013? No Yes

40. Please describe the accident in a few words; try to explain it chronologically, like in this example (first, then, finally)

Story example : I was riding on a cycle lane, when suddenly a car door opened. First, I tried to avoid it and I swerved into the left lane. Then, a car coming from behind me hit my handlebar with its wing mirror. Finally, I lost control and my front wheel hit the kerbside, I went over my bike and I hit a street light.

Your story :

We thank you very much indeed for your participation.
 Please send back the questionnaire using the pre-addressed envelope (stamp not required).
 If you lose it, address a regular envelope to :
 Alice Grasset, IFSTAR-UMRESTTE, 25 av. F. Mitterrand, case 24, 69675 BRON cedex

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FIGURE 1 Questionnaire for a cyclist accident typology set up

The fact that the respondent group was more often cycling on city roads may go together with women overrepresentation in the respondent sample. Indeed, men practicing sport out of town and having an increased risk of single vehicle crashes are mainly non-respondents. The bigger proportion of collisions in our respondent sample is explainable by a double bias. The first one is a memory bias meaning people remember more easily an accident with a third party involved in an avoidance or a collision than a cyclist-only fall. The second is a self-selection bias which is the tendency to better be disposed to talk about an experience when someone else is involved because the cyclist feels unfairly involved. To sum up about non-response bias, we can suppose that it will not be a big problem to build up the typology because all distinctive types of accidents should be present in the statistical analysis. However, the population distribution in each type of accident may not reflect the reality and must be weighted. There are many adjustment techniques available in statistical literature that can be used if required [26, 31-33]. To conclude on biases, differences between respondents and non-respondents suggest to test different models in which some variables (age, gender and type of practice) will be included as constructive and explanatory to build up a typology of cyclist accidents.

All findings will be based on compiled cyclists' points of view and on a declaratory basis. Obviously, we do not take into account any other perspective: neither the witness nor the third part of the accident, if any. Nevertheless, there exists no study to our knowledge that determines if the typology accuracy would be better using other people's testimonies. From detailed accident studies analysis it appears that in most of the cases, cyclist declarations and testimonies, are coinciding on major accident factors collected in our questionnaire. Indeed, some details differ between cyclist and third part views (speed, exact trajectory...). Moreover if those details are crucial to build up prototypical scenario or crashes simulations, they are not in our typology construction. Also, we can assume a better efficiency of a cyclist accidents typology built by cyclists' declarations for single-crash accident prevention addressed to them.

CONCLUSION

The Cyclist Accident Typology survey is unprecedented in its scope in terms of number of participants (more than one thousand) and representativeness, the medical registry covering 80% of injured cyclist. In France, injured cyclists have been surveyed taking into consideration the circumstances of their accident from the lowest to the highest injury severity and for the very first time. The questionnaire improvement is detailed and can be used as an example for other studies. The response rate of 43 % for this postal survey partly ensures the quality of the main analysis results detailed in a next article. Some of the variables that influence response propensity have been identified; hence the typology results could be weighed. Although statistical analyses have to be done, some of the results presented here are already a first step toward a better cycling safety knowledge.

ACKNOWLEDGMENTS

The authors wish to thank the French Institute for public health surveillance for funding this research project, all the persons who took part in data collection and data recording, both within the Rhône Road Trauma Registry association (ARVAC, president E Javouhey), and within the IFSTTAR-UMRESTTE research unit (B Laumon, scientific adviser and A Ndiaye medical coordinator), all members of our research unit for their kindness and good advices about questionnaire revisions and packing/sending off. Cyclists associations in the Rhône to have made their members aware of the pilot survey and of the interviews, the 1078 victims who took time to fill the form and return the questionnaire, especially the several ones who sent us long letters to thank us for our interest in this subject, the few family members who contacted us to report the death of loved ones.

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