Underreported accidents on Indian roads

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Abstract - India is a country with a highly increasing economy and an enormously growing mobility and increasing road traffic. But results out of that also show - India has a very large number of road fatalities (150 785 in 2016) [1] and therefore countermeasures are required to improve road traffic safety. Official statistics provide important facts about the current accident situation in India. Nevertheless, in the annual report from the Ministry of Road Transport and Highways (MoRTH) it is pointed out that not all traffic accidents are reported. Within the report a few different reasons for underreporting are listed. In order to get a clear understanding about the whole traffic accident situation in India, it is necessary to get more information about underreported cases and their overall share. The knowledge about the whole accident situation will ensure that measures regarding traffic safety are set accordingly to its needs and more realistic and reliable potential and benefit estimations of various traffic safety solutions are guaranteed. Therefore, the RASSI database was used in which not police reported accidents are collected. By comparing to national data a method was developed to identify the share of not reported cases. As main finding it can be concluded that the major underreporting is given for accidents with slight injuries and severe injuries. Fatal crashes are well represented in the National statistics. Overall, it is estimated that around 1 080 000 accidents with casualties occurred in 2016 in India. Using this methodologies further countermeasures can be derived to improve road traffic safety in India.

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NOTATION

P2W	Powered Two-Wheeler
RASSI	Road Accident Sampling System India
MoRTH	Ministry of Road Transport and Highways (India)
OEM	Original Equipment Manufacturer
NH	National highway
SH	State highway

MOTIVATION

The official Indian accident statistics show that the number of road accidents and fatalities are one of the highest worldwide [2]. The current official accident statistic shows, that the trend of increasing number of fatalities is not stopped. In 2016, the number of 150 000 fatalities on Indian roads in one year was exceeded for the first time [1]. These official statistics also provide important facts about the current accident situation. To reduce the high number of accidents in the long term, it is necessary to gain more detailed knowledge about the accident situation in general, in particular also about unregistered accidents which are an unknown part of the accident situation in India. That the phenomena of underreporting are existing in India was already stated in previous official reports and studies. For example, the official annual report in 2008 on page 25 pointed out that not all traffic accidents are reported by the police [3]. There are different reasons known for such underreporting. The Road Traffic Injury Prevention report in India lists some root causes for underreporting [4]:

- Agreement between individuals involved in a crash is often found to be a suitable method between the parties, as involving police would lead to additional costs
- Individuals do not feel the need to report to police unless the injury is serious, results in legal proceedings and influence compensation process
- Individuals provided care by general practitioners; nursing homes and smaller health care institutions are not reported to police to avoid harassment and legal complications
- Limited manpower and facilities among police often make reporting very difficult
- As there is no reporting practice on all deaths and injuries to any single agency from all health care institutions, information is not totally available within the health sector

Different studies show the existing phenomenon of underreporting traffic accidents in India. One example is given by the “National Institute of Mental Health & Neuro Sciences” which was supported

by the Ministry of Health & Family Welfare, New Delhi, and the World Health Organization. The results show that 3 out of 4 traffic casualties in and around Bangalore are not registered by the police. [5] Furthermore, findings out of independent hospital and population-based research studies related to road traffic crashes describe the considerable underreporting.
A study in Bangalore compared police and hospital deaths and found underreporting of 5% for deaths and more than 50% for serious injuries. [6] Another study from rural Haryana estimated the ratio of serious:moderate:minor injuries to be 1:29:69 and therefore a significant underreporting of injuries and accidents. [7]
An initial investigation using the RASSI database (Road Accident Sampling System India) also showed a clear presence of the phenomenon of underreporting. [8] This study uses these findings along with current official statistics and a significantly higher number of analyzed in-depth cases in the RASSI database.

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AIM OF THE STUDY

This analysis aims to understand the real traffic accident situation in India by taking into account that not all accidents are reported to the police or listed in the official statistic. The results are intended to show the specific characteristics of this type of accidents. This enables to determine the approximate real number of accidents on Indian roads.

DATA SOURCES FOR ROAD TRAFFIC ACCIDENTS

Baseline for the research are national accident statistics annually published in the MoRTH report along with in-depth data provided in the RASSI database.

Official accident statistic

'Road Accidents in India' is an annual publication of the Transport Research Wing of the Ministry of Road Transport and Highways, Government of India. The Transport Research Wing is the nodal agency for providing information data on road transport and roads and covers different aspects out of this including road accidents in the country throughout the year. Information is collected by the Police Departments of the respective Union Territories or States. The latest MoRTH report for the year of 2016 (published end of 2017) discloses 480 652 police reported accidents in India. [1]

Severity	Reported accidents (maximum of injury severity)	Persons
Fatal	136 071	150 785
Severe injured	120 848	175 009
Minor injured	187 642	319 615
No injury	36 091	n. a.

Table 1. Reported accidents and casualties in India by severity [1]

The official report also contents some further tables like category of fatal road users, street design and classification, weather details, crash configuration, time of the crash. Most of the statistics are separated by the states and main cities.

In-depth accident data

The Road Accident Sampling System – India' (RASSI) is a consortium- organized project of national and international Original Equipment Manufacturer (OEM) and suppliers (www.rassi.org.in). Since 2011 evidence based data collection of road traffic accidents on the spot in currently five different regions in India has been investigated. Initially, the data of RASSI was limited to certain sections of roads in rural area. Since the beginning of the scientific data collection of accidents on Indian roads, the investigation area has been continuously expanded and extended to several places in India. Currently, urban areas are also being investigated. The ongoing expansion of the investigation areas will ensure that study results based on the RASSI are representative for whole of India. The current investigation areas cover national and state highways including several connection roads, as well as the Mumbai-Pune-Expressway and also urban areas of different cities since 2015. The accidents in RASSI are notified by different sources:

1. Police
2. Medical rescue services and hospitals
3. Own patrols and witnesses

Furthermore, the RASSI accident documentation in general, shows that in many accidents a notification by the police is given but related official files are not created due to various reasons as already mentioned. Anyhow, this also results in underreporting of crashes. The system of RASSI compares whether to the collected cases an official case file exists and stored this detail in the database for each case.

At the time of the study 2 336 accidents were fully documented in the RASSI database. Table 2 shows the number of collected cases with respect to the investigation area all around India. [9]

Investigation area	RASSI Cases
Coimbatore	1 160
Mumbai-Pune Expressway	567
Ahmedabad	385
Kolkata	138
Jaipur	40
temporary investigation areas	48
Total	**2 336**

Table 2. RASSI full documented accidents (Status Jan 2018) [9]

Content of the RASSI database are accident wise information about infrastructure, weather, road conditions, vehicle details, vehicle damage, involved persons, injuries, contributing factors. Additional to the digital data, an extensive set of picture documentation and a measured scene diagram is available, as well.

By start of the RASSI activity, the focus was on accidents in rural area mainly on national and state highways including their connecting roads. With implementation of further investigation areas, the special road type of Expressway and urban areas have become content of the current data, as well.

For this study all 2 336 accidents were considered and compared to a previous study recently published in [8]. As example cases from Kolkata applied different case selection criteria (only fatal cases) hence the overall representative was limited. The notification of accidents for the current dataset now follows a consistent selection criterion for all investigation areas including Kolkata.

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Severity	Reported accidents (maximum of injury severity)	persons
Fatal	1 016	1 298
Severe injured	749	1 968
Minor injured	373	1 518
No injury	198	2 872
Total	2 336	7 656

Table 3. Reported accidents and casualties in India [9]

RESEARCH METHOD

The main component of this study is the determination of the underreporting rate for each chosen accident category. This enables a re-calculation of national data by considering the underreporting rate for each parameter. Overall this method allows an extrapolation towards national level more easily.

Figure 1 compares the number of accidents which reported in RASSI as an example. In ① the number of accidents reported to both, police and RASSI investigation is seen, and to ② gives the number of cases which are reported to RASSI only. The ratio out of them is defined as *underreporting rate* ③ and describe the share of all not police reported accidents within the same category ④. As an example the underreporting rate of 32% is determined if accidents considered in which a car was involved. In other words, two out of three crashes involving a car in India is reported to the police. To get the relation to the total number of all accidents, in every figure the category "all accidents" is placed on the top of the figure.

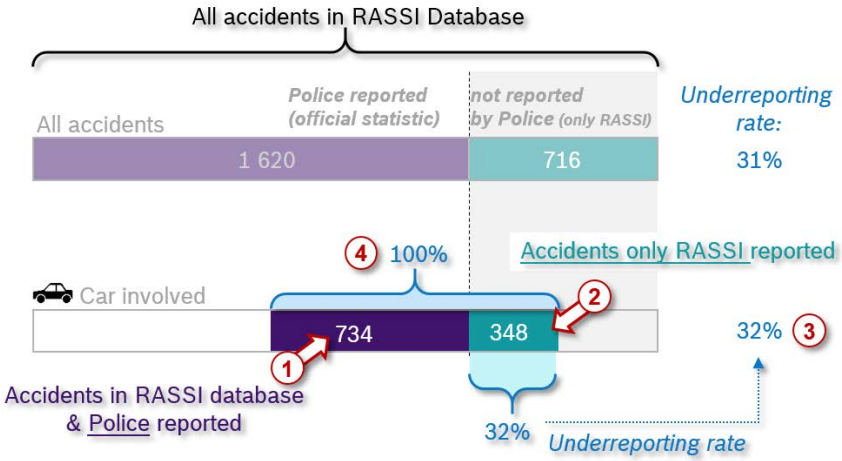

Figure 1. Underreporting of accidents (Example with description)

This allows to project various parameters towards national level in India in case the information is available in the national report. Following this approach for various categories the underreporting rate was determined and compared against national data.

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RESULTS

As mentioned already underreporting is given for various reasons nevertheless the injury severity can easily be seen as one major causes for underreporting. Therefore, it is evident to verify the number of cases by severity level. Figure 2 shows the underreporting distribution of the in-depth data by severity.

The theory of higher injury severity accidents having a smaller underreporting rate than accidents with minor injury severity is clearly verified by RASSI data. Only 1 of 4 accidents with minor injury (also hospitalized less than 24h) are reported by the police. 43% of investigated accidents are fatal. Nearly all of them are also reported to the police. But few accidents (1%) are not registered, either.

By projecting based on the current RASSI data and official statistic for whole India a number of ~1 600 underreported fatal accidents will be the result. 32% of all investigated accidents are crashes with a severe injury. Every third accident cannot be found in the official statistic or in other words two out of three crashes are reported to the police.

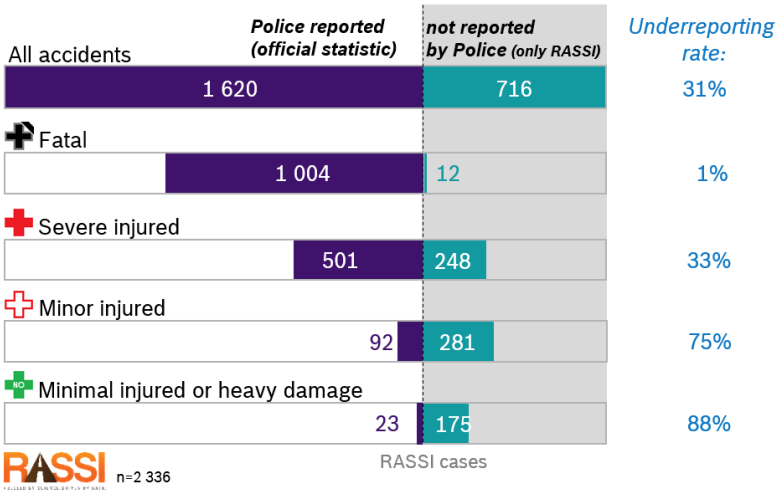

Figure 2. Underreporting by accident severity

The big differences between the underreporting rate of fatal (1.2%) and severe injury crashes (33%) did not allow a general projection from well documented fatal accidents to all accidents (injured and non-injured) in India. For determination of the real number of accidents in India, it is therefore necessary that the underreported accidents are also considered. The difficulty lies in the consideration of diversity of underreported accidents in the different categories.

Comparing the ratio of fatal:moderate:minor injuries determined to 1:33:75 from RASSI against the study from rural Haryana [7] estimated to 1:28:69 respectively it is seen that the results are rather similar. Therefore, as an interim result it can be concluded that the underreported cases from RASSI can be used to estimate the overall number of crashes with casualties in India.

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Total number of accidents with casualties in India by severity and road category

By using the determined underreporting rates and the accident numbers from official statistics a number of around 1.08 million accidents with casualties can be calculated for 2016 (Table 4).

Severity	Reported accidents [1] (maximum of injury severity)	Underreporting Rate (missing)	underreported accidents	projected number including underreporting
Fatal	136 071	1.2%	~ 1 600	~ 137 700
Severe injured	120 848	33%	~ 60 000	~ 181 000
Minor injured	187 642	75%	~573 000	~ 761 000
	Total Number of accidents with casualties:			**~ 1 080 000**
No injury (mainly heavy damage)	36 091	88%	~ 275 000	~ 311 000
Total	*480 652*		*~ 910 000*	*~ 1 391 000*

Table 4. Total number of accidents (2016) with casualties in India (including underreporting)

By analysis of road category (seen in figure 3) it is seen that collisions on expressways are highly underreported. Nearly every second accident is not documented by the police. One root caused can be identified by analysing accident scenarios and road user categories. Accidents on expressway are mainly characterized by single vehicle accidents (loss of control and falling asleep). Typical accidents on highways are also crashes between vehicles of the same vehicle category. Car vs. Car and Truck vs. Truck accidents also have a higher underreporting than all accidents. [8]

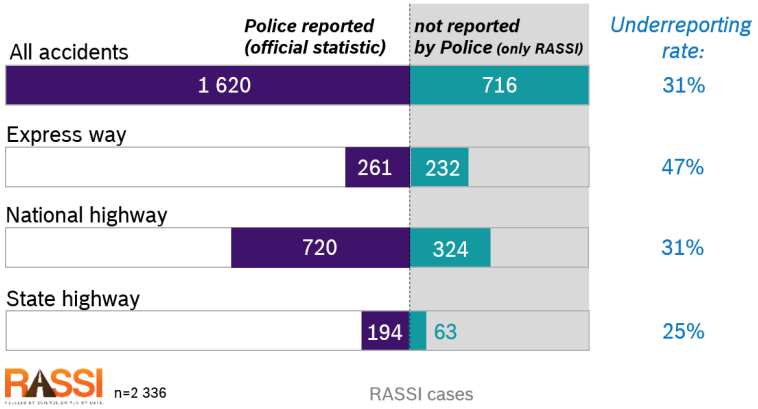

Figure 3. Underreporting by road category

The Express Highway network is continuously expanding in India and now covers about 1.2% of the total 100 million km National Highway Network [10]. For the accident projection the underreporting rate of National Highways is used. Due to the fact that nearly 80% of all collected accidents in RASSI occurred on Highways (National & State) the projection for NH and SH is calculated by using the underreporting rate of RASSI only. The number of accidents on "other" roads (district roads, rural and village roads) is calculated by considering the total number of accidents out from Table 4.

Street category	Reported accidents [1]	Underreporting Rate (missing)	underreported accidents	projected number including underreporting
NH (incl. Express Highway)	142 359	31%	~ 64 000	~ 207 000
SH	121 655	25%	~ 40 000	~ 161 000
Other	216 638	79%	~ 807 000	~ 1 023 000
Total	*480 652*		*~ 910 000*	*~ 1 391 000*

Table 5. Accidents (2016) by road category in India (including underreporting)

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The high number of underreported accidents on "other" roads is mainly due to minor injury crashes and accidents with property damage only as result of lower travel speed on secondary roads (e.g. village roads).

Type of accidents and vehicle involvement

RASSI data shows that every second accident with rollover or an initial object collision in not reported by the police. Such accidents are often characterized by loss of vehicle control or precedent skidding. Accident situations with mainly severe injury severity like head-on collisions or pedestrian conflicts are less underreported.

Not all results of RASSI can be extrapolated for the whole of India for example Hit & Run accidents currently are not content of RASSI investigation because the investigations in such cases are very difficult. As seen from the official statistics 55 942 Hit & Run crashes were reported which is an overall share of 12% of all crashes in India. Also other accident situations are not fully covered in RASSI: Rear End collisions in urban areas especially with minor injuries are highly underrepresented in the database.

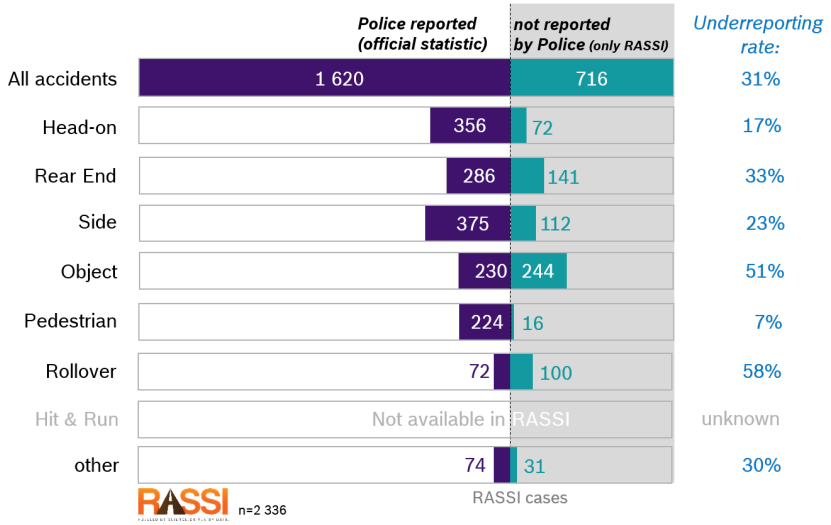

Figure 4. Underreporting by crash configuration

Every second accident in RASSI is characterized by car involvement. Every third of these car accidents is not documented by the police. In case of a car single accident like a loss of control without involvement of other vehicles every second accident is not considered in the official statistics (figure 5). This kind of accidents are often characterized by an object collision or a rollover event and the high underreporting rate is also seen in the distribution of crash configuration (figure 4).

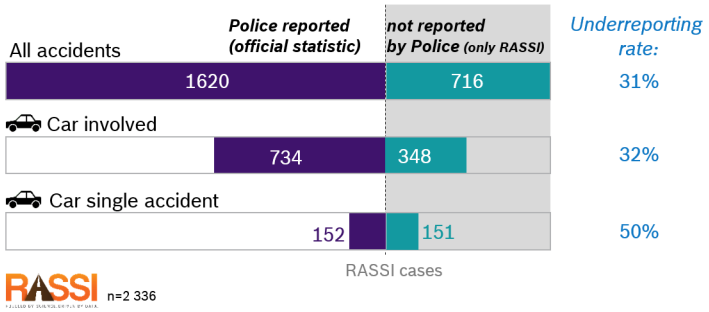

Figure 5. Underreporting in passenger car accidents

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Trucks also have a high relevance in the accident situation on Indian roads. Based on the in-depth database sample 42% of the accidents occur with a truck being involved. The category of truck single accidents (~8% of all accidents) shows a very high underreporting rate. Only 23% of these accidents are registered by the police and pointed out in the statistics (figure 6). It is evident that truck drivers handle the situation without the police either to continue their travel immediately or not to be punished by police. As a matter fact driver drowsiness is one of the major root causes of truck accidents on Indian highways.

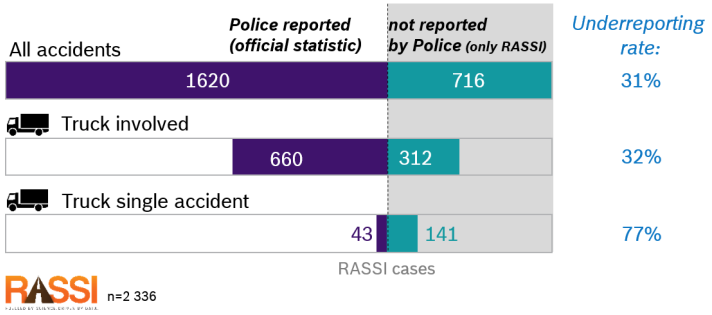

Figure 6. Underreporting in truck accidents

Accidents involving a powered two wheeler (PTW) seemed to be covered well in official statistics. Nearly every sixth crash is not reported by the police. It is assumed that even in RASSI these crashes are not reported very well due to the fact that single vehicle crashes without further participants might be either reported to police or hospital if not very severe injuries happened. Nevertheless, it is seen that they are not fully covered in national accident data, either.

Accidents involving pedestrians, however, are well covered in police reports. Considering the severity of these accidents it was found that the cases are mainly severe or fatal. It is evident that in such cases another party is involved. Thus, the police is interested in finding out the circumstances of these accidents. However, pedestrian accidents with only minor injuries and minor vehicle damage (e.g. low speed accidents in urban scenarios) are sometimes not covered by RASSI because these accidents spots are cleared quickly. Such accident situations are often clarified between those involved persons without involvement of police or ambulances. In addition, some pedestrian crashes (especially at night time) are hit & run cases which are currently not recorded in RASSI. These two additional pedestrian accident situations (low injury severity or hit & run) could also result in a higher underreporting rate (at this time unknown).

Taking a closer look to the combinations of different vehicle types involved in one accident, important findings can be seen (figure 7). Truck vs. truck accidents have a high underreporting rate of 40%. It is assumed that truck owner clarifies the issues between themselves without involvement of police. Also car vs. car accidents are higher underreported due to the often lower injury severity (for example like in rear end collisions). Lower underreporting rates are seen in accidents car or truck vs. powered two wheelers. These accidents usually have a very high injury severity and the motivation to involve police is much higher than accidents with less injury severity. The amount of underreporting has thus a direct relationship to crash compatibility which is reflected in the initially examined injury severity.

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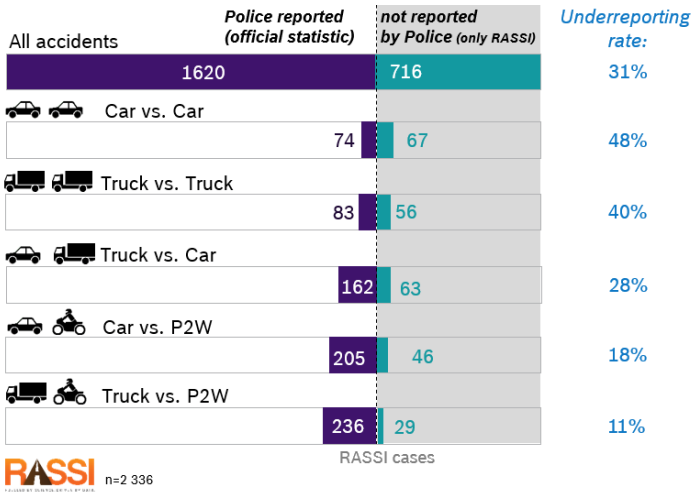

Figure 7. Underreporting in different accident constellations (vehicle type)

Further results regarding underreporting were determined regarding accident time, infrastructure and weather conditions. Night accidents and accident out of the typical "working" time have a higher underreporting rate. It is assumed that this is a result due to lower traffic density, thus, there is a higher share of single vehicle accidents or less police availability during night time. Influence of infrastructure or weather condition is visible in other accident characteristics like "single vehicle accidents", "object collisions" or "rollover" or is directly related to the street category (Express highway, NH, SH)

As a next step, the findings of this study can be used to develop a robust extrapolation method for whole of India. In addition, the methodology of this study can be used to monitor any changes in the phenomena of underreporting in the future with updated datasets of RASSI and official statistics.

SUMMARY

The current analysis of in-depth accident database RASSI points out an average underreporting of 31% of all cases. Basis of the analysis was the current dataset of 2 336 documented accidents out of more than five different investigation areas. Due to the investigation criteria the RASSI data is biased in direction to severe and fatal accidents. By knowing of the underreporting rate in RASSI and the official accident numbers, the general underreporting rate can be determined. Official number of 444 561 registered accidents with casualties and the additional ~635 000 non-reported accidents with injuries gives a number of ~1 080 000 accidents with casualties for India. Out of these accidents, 59% are not reported.

One important open question is how many accidents are not included in RASSI and official statistics. It can be assumed that the current projected accident numbers will again be slightly larger if these accidents are taken into account. However, the largest share of these unknown accidents will only be characterized by very slight damage or minimal injuries, so that this has no influence on the social focus of reducing the number of road deaths and severe injuries.

Indian highways are in focus regarding traffic safety. Official statistics [1] say that 62% of all road fatalities happen on only 5% of Indian roads – the national and state highways. This sad fact is also visible in the RASSI data: 43% of investigated accidents are fatal accidents and 76% of investigated accidents occurred on Indian highways. Accidents on Express highways have a higher underreporting rate due to the typical accident scenarios like loss of control or falling asleep related situations. On Express highways the number of accidents with vulnerable road users is less compared to other road types. Taking into account the official accident numbers, it becomes apparent that the highest

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underreporting rate is on secondary roads or within urban areas. This can be explained by the higher number of accidents with minor accident severity.

The study shows that fatal accidents only have a minimal underreporting. In case of accidents with minor injured persons or accidents with a high property damage the majority of these accidents are not reported by the police. Several causes with regard to underreporting are found. Single vehicle accidents are highly underreported: Every second single car accident is not noticed by the police. In the category of truck, the underreporting rate is even higher. Four of five single truck accidents do not appear in the official statistics. It is supposed that single motorcycle accidents also have a very high underreporting because even RASSI has a number of undetected cases, as well. In case of single motorcycle accidents less information is available because these accidents are quickly cleared and retrospective investigation is not possible.

In case of vulnerable road user's involvement, the underreporting rate drops down till 11% (truck vs. motorcycle). These kind of accidents often are characterized by high injury severity. In these cases, participants (mainly VRU) are strongly interested in involving the police. In case of a reduction of underreporting in future, it is possible that the official number of accidents and injured road users are suggesting a deterioration of road safety because of increasing number of reported accidents.
Therefore, the official accident statistic will leave much room for interpretation in the next years and shows the need of independent in-depth accident investigation in order to get an insight in the real accident situation. In-depth accident investigation like RASSI is able to observe the trend of underreporting in the next years.

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REFERENCES

[1] Government of India, Ministry of road transport & highway, Transport research wing, New Delhi, www.morth.nic.in, ROAD ACCIDENTS IN INDIA – 2016

[2] Global Status Report on Road Safety 2015, WHO Library Cataloguing-in-Publication Data, World Health Organization 2015, ISBN no: 978 92 4 156506 6

[3] Government of India, Ministry of road transport & highway, Transport research wing, New Delhi, www.morth.nic.in, ROAD ACCIDENTS IN INDIA – 2008 Page 25

[4] Report on Road Traffic Injury Prevention in India Annexure to the Report (Volume-II) Report of the Committee on Road Safety and Traffic Management

[5] National Institute of Mental Health & Neuro Sciences, Department of Epidemiology, WHO Collaborating Centre for Injury Prevention and Safety Promotion, Bengaluru – 560 029, India: Bengaluru Injury / Road Traffic Injury, Surveillance Programme: A feasibility study, 2008, ISBN no: 81-86423-00-X

[6] Gururaj G, Thomas A, Reddi MN. Underreporting of road traffic injuries in Banglore: Implications for road safety policies and programmes. In: Proceedings of the 5th World conference on injury prevention and control. New Delhi: Macmillan India; 2000.

[7] Varghese M, Mohan D. Transportation injuries in rural Haryana, North India. In: Proceedings of the International Conference on Traffic Safety. New Delhi: Macmillan India 2003; p. 326-9.

[8] J. Moennich, Girikumar K., T. Lich, A. Georgi, „Analysis of Non-Police Reported Accidents on Indian Highways", SAE Technical Paper 2017-26-0005, 2017, doi: 10.4271/2017-26-0005.

[9] Road Accident Sampling System - India (RASSI); www.rassi.org.in

[10] National Highway Authority of India (Ministry of Road Transport & Highways Government of India http://www.nhai.org/roadnetwork.htm