Comparing IDB data with injury data from other sources

Protocols for the comparison of IDB based indicators with indicators from other information sources such as discharge registers and health surveys.

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D 9.2.5: Technical report on comparing IDB data with other sources on injury data.

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1. Introduction and background

The EU IDB is a unique data source that contains standardized cross-national data on the external causes and circumstances of injuries. Subject-matter is patients examined and treated in emergency department of hospitals (EDs). IDB contains almost exclusively non-fatal injuries and complement death statistics. Main purposes of IDB is to monitor injury risks and facilitate the development of preventive actions. Its methodology is comprehensively laid down in the IDB Operating Manual [1].

IDB data are collected by dedicated national agencies and uploaded into the EU IDB data base, which is hosted by the DG Santé (Health and Food Safety), to make information available for various stakeholders as governments, researchers and safety promotion agencies. At EU level, the system is legally based on the Council Recommendation on the Prevention of Injury and the Promotion of Safety 2007 [2] and the EU Regulation on Community Statistics on Public Health and Health and Safety at Work 2008 [3].

The EU system is designed to deliver public health indicators on all kinds of injuries, at national as well as on EU level. Main deliverables are rates of home, leisure time and school accidents, road traffic and work-place accidents, injuries due to assaults or deliberate self-harm – for entire national populations or sub-groups as age-groups, females or males. Most of the European Core Health Indicators (ECHIs) dealing with injuries can be produced with IDB data. IDB data are currently publicly accessible at the EU IDB web-gate [4] and at the ECHI web-gate [5] for ECHI-29b – home, leisure time and school accidents [6].

Although IDB data should be recorded on every patient treated for injury in *every hospital based ED*, there are still many IDB countries which collect data only in samples of hospitals, which makes projections necessary [1][7][8]. This led to the question, how accurate and valid IDB based estimates are or, at least, can be.

There are other, less specific, data sources providing information on injuries: hospital discharge registries and household surveys on self-reported health problems deliver also indicators for the health burden due to home and leisure or road accidents. But the figures provided by these data sources may differ substantially from IDB data. This leads to the following questions: 'what is the extent of these differences', 'what causes for the differences' and 'how best we can use these different data sources for guiding public health actions on injury prevention'.

2. Purposes of this report and main target groups

The first part of this report tries to answer the question as to how the validity of IDB estimates can be assessed. Validity is the extent to which a measurement corresponds accurately with the real world. IDB based estimates cannot be validated by reference to injury morbidity, which is actually unknown. However, the number of hospital discharges due to injury is a meaningful and practicable reference. Hospital discharge statistics exist in all EU member states and pretend to cover all or almost all inpatient treatments. A certain percentage of IDB cases get admitted to inpatient treatment. IDB-admissions can be seen as a random sample of all admitted injury patients. Therefore, in most IDB countries national hospital discharge statistics are used as reference when estimating IDB injury rates.

In the past, national IDB estimates showed greater variations than national hospital discharge figures for injury. To a certain extend this is expected as long as countries do not include all hospitals in their IDB-data collection system (work on a sample of EDs in hospitals).

The IDB-network identified quite some issues with sampling and estimation methods. These issues have been addressed in course of the previous JAMIE-project [9] and the current BRIDGE-Health project [10], in order to increase validity, accuracy and comparability of IDB based estimates:

- The inclusion/exclusion criteria (definition of cases) have been formulated more precisely, implemented in national IDB systems and applied to reference statistics, when estimating IDB based rates.
- The requirements for sample of hospitals have been tightened and methods for a better monitoring of the representativeness of hospital samples have been introduced.

These quality requirements have also been incorporated into the IDB quality control systems, i.e. the templates for national IDB implementation score card reports and for the national IDB file information forms, which accompany every national data file. Today, these requirements need to be complied by national IDB data administrators. The according reports on the status of system implementation and data quality are published at the EU IDB and Eurosafe data web-sites [11, 12].

As long as national rates are estimates, based on samples, it is crucial to continuously assess and monitor how valid and accurate these estimates are. This report proposes a procedure how to assess this question at national level, applies the protocol in an exemplary manner and compares IDB estimates with figures from hospital discharge registers.

The second part of this report deals with the question, how relevant IDB data are compared to other injury data sources. Next to hospital discharge statistics, household surveys may produce estimations of injury incidences in countries. In particular the European Health Interview Survey (EHIS), which is the recommended data source for some European Core Health Indicators (ECHIs) based on self-reported incidences, is in this respect an interesting source of data. The purpose of this study is to assess strengths and weaknesses of both approaches (IDB and EHIS) and the impact of different methodologies on estimates.

IDB based indicators do not only reflect actual injury-morbidity, but also particularities of national health care systems, i.e. the relative accessibility of emergency departments of hospitals compared to primary care facilities. In countries with easy and free access to outpatient services many more cases will be reported than for instance in countries where patients need permission by primary health care staff before getting access to hospital care – even when the morbidity in both countries is exactly the same. Therefore, IDB rates can be interpreted as morbidity indicators only for a given health care system, and as long as no substantial changes in this system take place.

Other, secondary measurements such as distributions of injuries over sub-groups (e.g. by gender, age-group or domains of prevention) are probably independent from the accessibility of EDs and very well indicators for injury morbidity differences of sub-groups.

In order to make use of the advantages of both methodological approaches, the ECHI short list contains for some groups of diseases indicators from surveys as well as from registers. This is the case e.g. for ECHI-29 “Home, leisure and school accidents”, where ECHI-29(a) is based on EHIS, and ECHI-29(b) on IDB.

Both questions - the one on validity and the other one on relevance – cannot be answered ultimately within the framework of the BRIDGE-Health project, but recommendations will be developed as to how to compare IDB with other data sources. Analyses presented in this report can serve as examples and guidance for assessing validity and comprehensiveness of available injury information, to be applied in future studies at national as well as at EU level, for specified sub-groups of injuries or population groups, and with more recent data.

The report informs decision makers about

- Validity and accuracy of IDB based estimates as ECHI indicators;
- Methodological differences between IDB and other data sources on injuries as hospital discharge registers, European Health Interview Survey (EHIS) and the European Statistic on Accidents at Work;
- Strengths and weaknesses of the various data sources and the specific information needs they serve.

Main target groups are:

- Public health epidemiologists, injury researchers and statistical officers working with injury data based on one or more of the in this report included sources (national statistical offices and bodies dealing with health data, members of the EGHI-group, researcher in the areas of public health and injury epidemiology);
- Decision makers in the areas of health information and health policies in member states (e.g. national public health institutes, ministries of health, health promotion and injury prevention agencies);
- Decision makers at EU-level (e.g. concerned EU Commission services as in DG Health and Food Safety, DG Justice and Consumers, Eurostat, Joint Research Centre, DG Research) and the EP, particularly members of concerned committees (e.g. Internal Market and Consumer Protection, Environment, Public Health and Food Safety).

The report has been produced in the framework of the following project:

- BRIDGE-Health project [6], Work package 9 “Platform for injury surveillance”
- It is mainly related to Task 2 “Expand IDB to remaining countries, maintain the current implementations and expand the scope to all injuries” and Task 3 “Maintain and further enhance the quality of implementations, monitor surveillance practice and assist countries in developing their systems”
- Deliverable D9.2b “Technical report on the sustainability of the IDB exchange at EU level under the new Health Information Infrastructure 2018+.”

3. IDB and hospital discharge register data (HDR)

Key figures from hospital discharge registers (HDRs) in EU countries are collected by Eurostat and published as ECHI-67 at the ECHI web-gate. In a first attempt to assess the validity of IDB rates, IDB estimates got compared with ECHI-67 figures, which leads to great differences between IDB and HDR rates for seemingly the same subject – hospital admissions due to injuries.

However, there are great differences of the case definition in these two systems and it was assumed, that the inclusion/exclusion of non-residents, complications of medical interventions, sequelae of injuries, day care patients, follow-up treatments and deceased patients account for most of these differences. Neither the ECHI nor the Eurostat website allow to select/reject such cases in order to form populations of HDR cases, which are comparable to IDB. An attempt was made to get this information directly from member states. Austria, Germany, Denmark, Netherlands, Sweden, Slovenia and UK provided sufficiently detailed HDR data to explore the influence of inclusion/exclusion of above mentioned sub-groups on HDR rates.

The percentages of these groups were subtracted from the all HDR cases, and the remaining percentage of cases considered as “correction factor” for achieving an IDB-equivalent HDR rate. Through this “correction”, the differences between HDR and IDB admission rates got much smaller, and the average rates of the seven countries got quite similar. This result indicates that different inclusion/exclusion criteria are the main cause for differences between HDR and IDB rates. IDB based rates are valid measurements for hospital treated injuries, when the IDB standards of sampling are applied.

Discharge register data

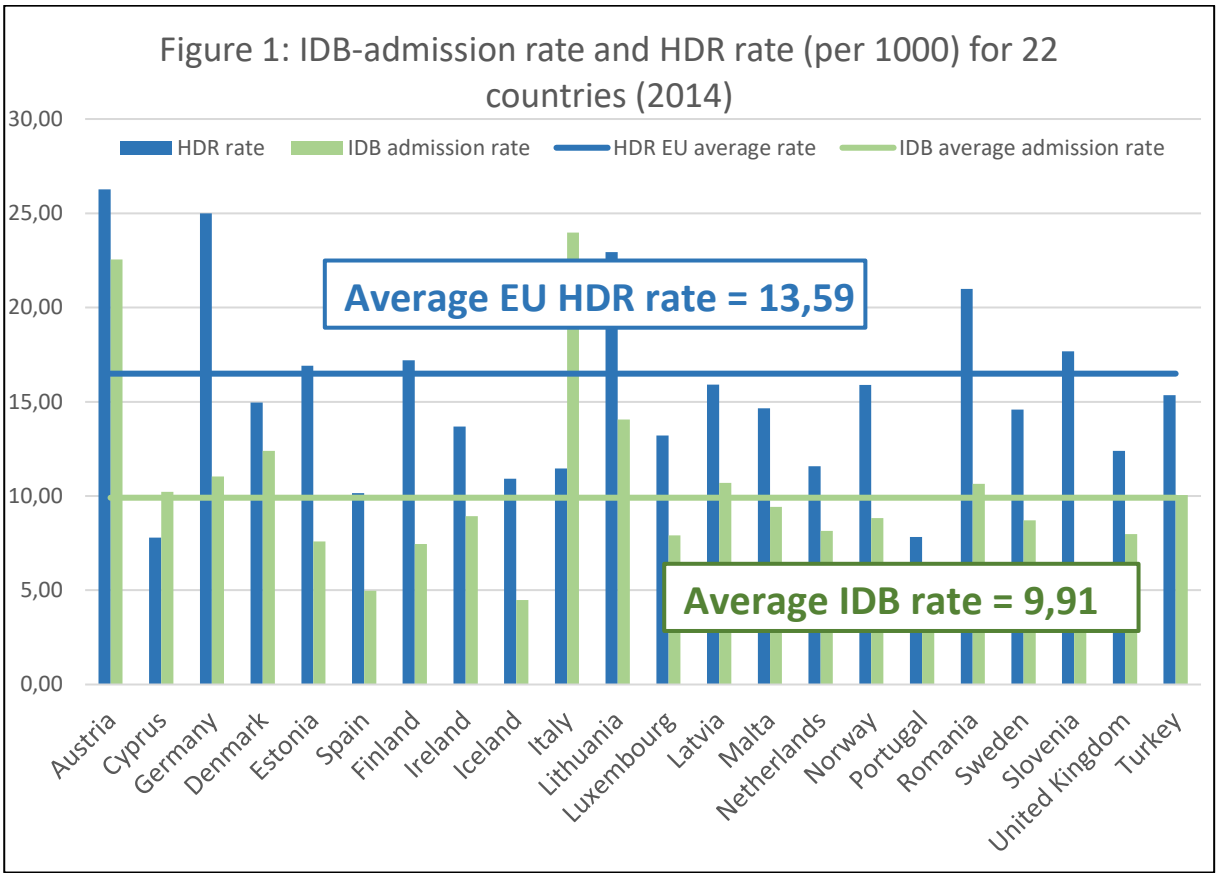
National hospital discharge figures get reported by EU countries to various international databases as WHO, Eurostat and DG Santé databases. Most appropriate in the given context is to use the ECHI web-gate [5]: ECHI-67 "Hospital in-patient discharges, limited diagnoses" contains the rates of hospital in-patient discharges for the 25 groups of health disorders of the International Shortlist for Hospital Morbidity Tabulation (ISHMT) [13].

"A hospital discharge is the formal release of a patient from a hospital after a procedure or course of treatment (episode of care). A discharge occurs anytime a patient leaves because of finalization of treatment, signs out against medical advice, transfers to another health care institution or because of death. An in-patient is a patient who is formally admitted (or hospitalized) to an institution for treatment and/or care and stays for a minimum of one night or more than 24 hours in the hospital or other institution providing in-patient care. Discharges by diagnosis refer to the principal diagnosis, i.e. the main condition diagnosed at the end of the hospitalization" [14].

ISHMT Group 1900 "Injury, poisoning and certain other consequences of external causes" comprises the ICD-10 chapter XIX, codes S00 – T98 (or ICD-9 codes 800 – 999). A first superficial comparison unveils rather huge differences between IDB based rates and ECHI-67 (table 1), although both stats are seemingly on the same subject.

Comparing incidence rates in IDB- and HDR-databases

The average HDR rate for injury in the EU-28 is 13.59 per 1000 inhabitants (average for the year 2014), while the average IDB rate for admissions is considerable lower with 9.91 (average of three years 2013-2015, 22 countries). For almost all countries, the HDR rate is higher than the IDB rate, except Cyprus and Italy. Figure 1 shows the rates for those 22 European countries, for which both indicators are available. HDR rates are for the most recent year, i.e. 2014, except for the Netherlands (2012) and Turkey (2011), and IDB rates are the average of the three most recent years (2013-2015). For more details on these IDB rates see the recent reports on injuries in the EU [9, 15].



Theoretically, HDR and IDB rates should be the same, as IDB samples should be random samples from the national populations of all admitted injury patients. The differentiation between admission (begin of the episode of hospital care) and discharge (end of the episode of care) can be neglected in this context. However, there are other differences, which may play a more significant role [1,16]:

- IDB collects data on all patients, independent from their country of residence. National HDR figures could include or exclude non-residents, e.g. tourists or foreign workers.
- IDB excludes complications of medical interventions (ICD-10 codes T80-T88 and T98.3 and/or Y40-Y84 and Y88, while these cases are included in ISHMT Group 1900.
- Sequelae (chronic conditions) of injuries (ICD-10 codes T90-T98 and/or Y85-Y89 are also excluded in IDB (which covers only acute injuries), but are included in ISHMT Group 1900.
- Day-cases are excluded in the IDB definition of “admitted”. Admission in ISB is equivalent to in-patient, which is a patient who is formally admitted to hospital care and stays for a minimum of one night or more than 24 hours in the hospital. Day case are formally admitted for diagnosis or treatment with the intention of discharging the patient on the same day. However, discharges in HDRs can refer to in-patients as well as to day cases.
- Follow-up treatments: IDB registers in principle just the first episode of treatment. Follow-up treatments (also follow-up admissions for the same injury) are excluded, but in HDRs every episode of treatment gets registered as a new case, even when related to the same injury.
- Different handling of persons deceased in hospital care could also make a difference.
- Injury can be defined either through the classification of diagnoses (ICD-10 chapter XIX, codes S00-T98) or through the classification of external causes of morbidity or mortality, i.e. ICD-10 chapter XX, V01-Y98 or through a combination of both.

Comparing IDB-estimates with more precise HDR-data from selected countries

Unfortunately, the international databases do not provide details on these questions. Therefor a template for a survey has been developed, which could be completed by national health data agencies, which have eventually more details on cases in their national discharge statistics.

Table 1: Template for reporting national injury discharges by varying definition and age-group				
Age-group	**ALL INJURY DISCHARGES ICD-10 S00-T98**	**ALL INJURY DISCHARGES ICD-10 V01-Y98**	**ALL IDB ADMISSIONS**	**NATIONAL POPULATION**
0-14				
15-24				
25-64				
65+				
All ages				
	WHEREOF….	WHEREOF….	WHEREOF….	Not applicable
	NON-RESIDENTS	NON-RESIDENTS	NON-RESIDENTS	
0-14				
15-24				
25-64				
65+				
All ages				
	COMPLICATIONS OF MEDICAL INTERVENTIONS **(T80-T88)**	COMPLICATIONS OF MEDICAL INTERVENTIONS **(Y40-Y84)**	Not applicable	
0-14				
15-24				
25-64				
65+				
All ages				
	SEQUELAE OF INJURIES **(T90-T98)**	SEQUELAE OF INJURIES **(Y85-Y89)**	Not applicable	
0-14				
15-24				
25-64				
65+				
All ages				
	DAY CARE PATIENTS (ZERO NIGHTS)	DAY CARE PATIENTS (ZERO NIGHTS).	Not applicable	
0-14				
15-24				
25-64				
65+				
All ages				
	FOLLOW-UP (SECONDARY) TREATMENTS	FOLLOW-UP (SECONDARY) TREATMENTS	Not applicable	
0-14				
15-24				
25-64				
65+				
All ages				
	DECEASED IN HOSPTAL	DECEASED IN HOSPTAL	Not applicable	
0-14				
15-24				
25-64				
65+				

All ages				

It is clear, that there are also other factors contributing, e.g. the quality and completeness of actual registration and coding. Nevertheless, in the given context, it is not feasible to gain data on this question.

In order to test the applicability of the template and to learn more about the potential influence of varying case definitions, a quick exploration study has been carried out. Some of the most dedicated and responsive members of the IDB-Network, which were known for having access also to other health statistics were invited to complete the form, i.e. the national IDB data administrators of Austria, Denmark, Germany, Netherlands, Slovenia, Sweden and United Kingdom. All these partners responded positively and provided their details HDR data as far as available, for the most recent year, i.e. 2015.

Table 2 shows the admission rates for injury (i.e. 2015) as reported by seven countries, and the estimated IDB admission rate per 1000 inhabitants.

Table 2: Admission rates for injury per 1000 from HDR (2015) and IDB (average 2013-2015) for seven EU countries

	Reported HDR rate 2015 based on all cases (S00-T98)	Reported HDR rate2015 based on all cases (V01-Y98)	IDB admission rate (average 2013-2015)
Austria	32,35	n. a.	22,55
Germany	23,81	n. a.	11,04
Denmark	17,50	8,94	12,39
Netherlands	11,39	16,97	8,14
Sweden	12,0	15,65	8,72
Slovenia	15,10	15,59	4,54
UK	15,8		7,97
Average of 7 countries	18,28	14,28	10,76

Again, there are huge differences between HDR based rates and IDB estimated rates, but interesting are also the differences between rates based on ICD-10 diagnoses (codes S00-T98) and those based on ICD-10 external causes (codes V01-Y98). In some countries, the diagnoses-based rates, in others the causes-based rates are higher, which indicates rather different coding practices. For UK only one rate has been reported, which is based on a combination of both groups of ICD-10 codes. Obviously, it can make a huge difference, which group of codes are used to establish “admissions”, which may lead to the question, how far HDR figures are valid and accurate. However, for ECHI-67/group 1900 the use of ICD-10 codes S00-T98 is required, for what reason we can here further focus on the HDR rates based on diagnoses.

What additional information on discharges is available in the various national HDRs, is shown in table3.

Table 3: Available additional information on hospital discharges by country

	Austria	**Germany**	**Denmark**	**Netherlands**	**Sweden**	**Slovenia**	**UK**
Non-residents	Yes	Yes	Yes	Yes	Yes, but not included in national HDR stats	Yes	Yes, partly
Complications of medical interventions	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sequelae of injury	Yes	Yes, but coding quality doubtful	Yes, but coding quality doubtful	Yes	Yes	Yes, but coding quality doubtful	No
Day care patients	Yes	Yes	Yes, but not included in HDR stats	Yes	Yes	Yes	Yes

Follow-up treatments	No	No	No, but by proxy algorithm possible	No	No, but by proxy algorithm possible	Yes	Yes
Deceased in hospital	Yes	Yes, but only residents	Yes, but completeness doubtful	Yes	Yes	Yes	No

The analysis of HDR data from these seven countries reveals that all the distorting aspects mentioned can play an important role and that it is crucial for a most accurate and valid projection, that the same inclusion/exclusion criteria are applied at both sides – IDB as well as HDR – as much as possible. Table 3 shows, that most, but not all aspects can be controlled for the time being. Particularly the identification of follow-up treatments remains to be a challenge.

Table 4 gives the percentages of cases, which needs to be considered when comparing HDR with IDB admissions (if cells are left empty, no data is available, either excluded or not coded).

Table 4: Percentages of certain groups of patients of all HDR discharges by country (empty, if not available)

	Austria	Germany	Denmark	Netherlands	Sweden	Slovenia	UK	Average
NON-RESIDENTS								
0-14	8%	1%	2%	1%		5%	4%	3%
15-44	9%	2%	3%	2%		4%	6%	4%
45-64	8%	1%	2%	1%		3%	5%	3%
65+	2%	0%	1%	1%		2%	3%	1%
all ages	6%	1%	2%	1%		3%	4%	2%
COMPLICATIONS OF MEDICAL INTERVENTIONS (T80-T88)								
0-14	3%	3%	4%	6%	5%	1%	4%	4%
15-44	7%	9%	12%	18%	13%	2%	9%	10%
45-64	10%	20%	21%	33%	22%	5%	19%	19%
65+	12%	18%	20%	31%	17%	7%	16%	17%
all ages	9%	15%	17%	26%	16%	4%	12%	14%
SEQUELAE OF INJURY (T90-T98)								
0-14	9%	0%	3%	0%	0%	0%		2%
15-44	13%	0%	4%	1%	2%	0%		3%
45-64	15%	0%	3%	0%	2%	0%		3%
65+	10%	0%	2%	0%	0%	0%		2%
all ages	12%	0%	3%	0%	1%	0%		3%
DAY CARE PATIENTS (ZERO NIGHTS)								
0-14	15%	4%		31%	22%	10%	51%	22%
15-44	14%	7%		34%	23%	9%	38%	21%
45-64	9%	3%		23%	11%	5%	29%	13%
65+	4%	2%		9%	4%	2%	16%	6%
all ages	9%	3%		21%	11%	6%	31%	14%
FOLLOW-UP (SECONDARY) TREATMENTS								
0-14						2%	6%	4%
15-44						4%	14%	9%
45-64						5%	14%	10%
65+						6%	6%	6%
all ages						5%	10%	8%
DECEASED IN HOSPTAL								
0-14	0%	0%	0%	0%	0%	0%		0%
15-44	0%	0%	0%	0%	0%	0%		0%
45-64	0%	1%	1%	1%	0%	1%		1%
65+	2%	3%	3%	3%	2%	4%		3%
all ages	1%	1%	1%	1%	1%	2%		1%

According to this analysis, non-residents inclusion/exclusion plays a role which cannot be neglected. The average for all age-groups and countries is 2%. The considerable differences between countries seem to be plausible and probably caused by different numbers of tourists and/or foreign workers.

Of much higher impact are complications of medical interventions (average of 14%). Unclear is the reason for rather big national differences; eventually this is the outcome of different levels of attention to coding quality.

Sequelae of injuries should also not be neglected. Although the average is just 3%, the huge national differences seem to indicate, that the coding of sequelae is not equally important for all countries. If this is the case, the percentage of sequelae gets underestimated in HDR figures. A most important role play day-patients with an average percentage of 14%.

Great national differences could be also caused by differences of the national health care systems. Follow-up treatments of one and the same injury do not get recorded in many countries, but seem to have quite some impact with 8% of all cases. The number of patients deceased in hospital care is rather low, with an average of all age-groups and countries of about 1% of all cases.

Finally, an attempt was made to estimate HDR rates, which correspond to IDB estimates (use the same case definitions). For this purpose, a very simple model was applied, which deduct the average percentages from the original 100% country by country, as far as appropriate: e.g. day-care patients were not deducted for Denmark, and non-residents not for Sweden. The assumptions are: 1) The average percentages of cases, which do not correspond with the IDB inclusion/exclusion criteria, are valid estimates, even when based on just a few countries; 2) All these cases are factually contained in reported HDR figures, even when not properly registered (coded), unless explicitly excluded. The results can be seen in table 5.

Table 5: Reported HDR rate, correction factor, corrected HDR rate and IDB admission rate by country

	Austria	Germany	Denmark	Netherlands	Sweden	Slovenia	UK	Average
Reported crude HDR rate								
0-14	20,32	18,82	10,37	7,68	7,59	10,73	15,70	13,03
15-44	23,28	14,86	11,99	6,89	6,90	10,85	13,01	12,54
45-64	29,08	17,61	15,88	10,11	9,68	13,53	11,18	15,30
65+	65,76	50,96	37,59	26,34	33,72	30,34	27,94	38,95
All ages	32,35	23,81	17,50	11,39	12,98	15,10	15,83	18,42
% of IDB equivalent cases (see table 4)								
0-14	68%	68%	88%	68%	71%	68%	68%	68%
15-44	60%	60%	76%	60%	63%	60%	60%	60%
45-64	60%	60%	69%	60%	61%	60%	60%	60%
65+	69%	69%	73%	69%	70%	69%	69%	69%
All ages	64%	64%	74%	64%	66%	64%	64%	64%
IDB equivalent HDR rate								
0-14	13,90	12,87	9,11	5,25	5,35	7,34	10,73	8,91
15-44	14,05	8,97	9,14	4,16	4,33	6,55	7,85	7,57
45-64	17,33	10,49	10,93	6,02	5,94	8,06	6,66	9,11
65+	45,12	34,96	27,48	18,07	23,43	20,82	19,17	26,72
All ages	20,83	15,33	13,04	7,33	8,56	9,72	10,19	11,86
IDB admission rate (average 2013-2015)								
All ages	22,55	11,04	12,39	8,14	8,72	4,54	7,97	10,76

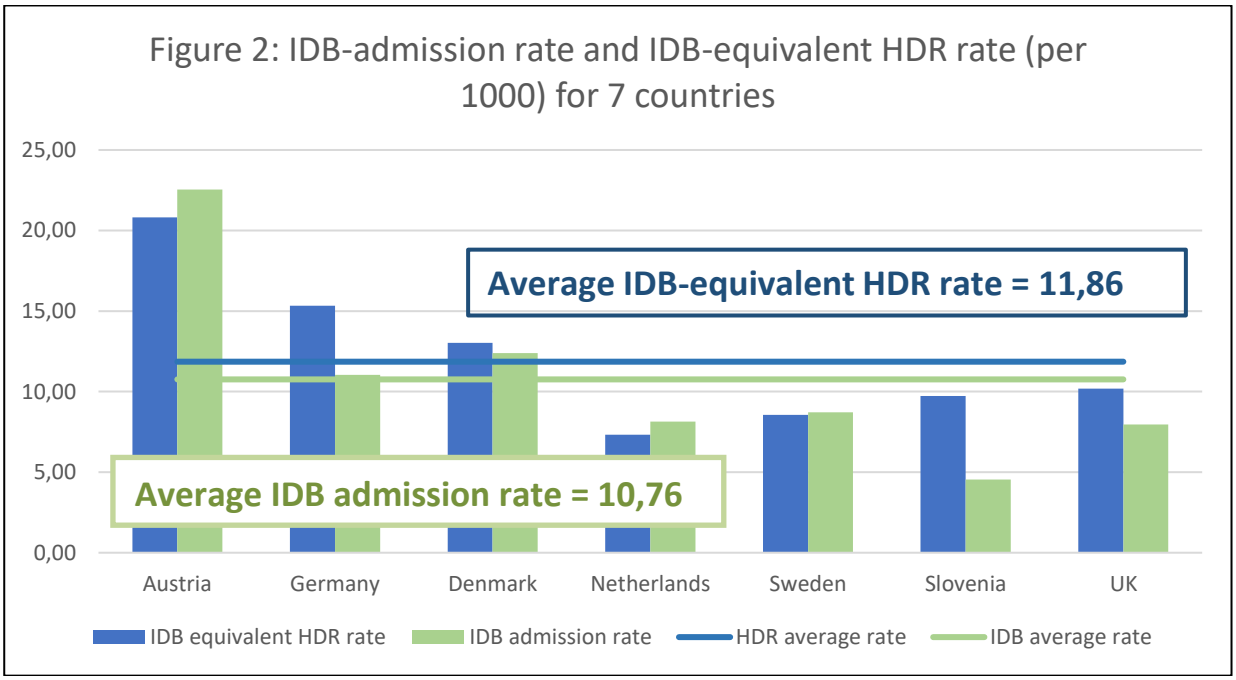


Figure 2 shows, that the "correction" results in HDR rates, which come much closer to the estimated IDB rates. Remaining differences could be the result of sampling biases (IDB) or factual national differences in HDR figures, which deviate from the averages of the seven countries in this demonstration study.

Preliminary conclusions as to HDR-data as reference for validating IDB-estimates
The results indicate, that the main differences between HDR rates (as ECHI-67/1900) and IDB rates are caused by different case definitions, i.e. inclusion/exclusion criteria. The differences are no reason for ignoring IDB estimates as valid and sufficiently accurate indicators for the burden of injury and to use them as ECHIs.

This is just a preliminary finding, further examinations are needed, particularly at national level. The above proposed protocol may help in this respect and would make the results of such exercises comparable.

A second recommendation could be to harmonize inclusion/exclusion criteria of these two related registers. The original intention of IDB was to produce most valid estimates for the true number of injuries in a country (i.e. by excluding sequelae and secondary treatments). However, as shown above, these numbers are highly biased by the accessibility of ED services anyway. Also, the deviant exclusion of day-patients, when counting admissions, should be reconsidered. This would not change the overall IDB rate much, but only slightly shift cases from "ambulatory treated" to "admitted".

4. IDB and EHIS

It is well known that health data stemming from registers are influenced by particularities of national health care system, which may affect the international comparability of register based indicators. Household surveys appear as way out, under the condition that the same methodology is applied in all countries. The European Health Interview System (EHIS) has been set up to deliver such sufficiently accurate, valid and internationally comparable health indicators on a broad scope of issues [17]. For some major problems (e.g. asthma, diabetes, home & leisure and road traffic injuries) it is recommended to use

both information sources – registers and surveys – which have different strengths and weaknesses. Although both systems register seemingly the same – acute injuries – EHIS and IDB based indicators differ widely due to methodological differences.

The fundamental differences get clear by a qualitative comparison of the metadata of the two systems. In particular the different scopes seem to play a crucial role: EHIS covers all injuries, also less severe ones, which are not treated or treated in primary health care facilities, while IDB register only the more severe ones treated in EDs of hospital, i.e. in secondary health care facilities. On the other hand, EHIS does not cover children and non-residents, which are included in IDB. For a qualitative comparison it would be necessary to create equivalent sub-sets of cases, but the ECHI website does not allow to select cases from EHIS data. National IDB partners were invited to carry out such qualitative comparisons of equivalent sets of cases at national level. Luxembourg and Denmark could follow this invitation in time. The results from these two countries indicate, that the different scopes explain most of the differences of the estimated rates.

European Health Interview Survey

The European Health Interview Survey (EHIS) aims at measuring, on a harmonised basis and with a high degree of comparability among member states, the health status, health determinants and use and limitations in access to health care services of the EU citizens. The survey contains questions regarding the general health status (e.g. chronic morbidity due to injury) as well as regarding disease-specific morbidity (e.g. acute injuries). The general coverage of the survey is the population aged 15 years or older, living in private households residing in the territory of an eligible European country. All indicators are expressed as percentages within the population (rates) [17, 18].

EHIS-questions on injury are:

- In the past 12 months, have you had any of the following type of accidents resulting in injury? Yes / No / Don't know / Refusal
- Did you visit a doctor, a nurse or an emergency department of a hospital as a result of this accident? Yes, I visited a doctor or nurse / Yes, I went to an emergency department / No consultation or intervention was necessary / Don't know / Refusal
- If yes, was it: Road traffic accident / Accident at work / Accident at school / Home and leisure accident?

The first wave of EHIS was carried out around the year 2008 and the second wave was implemented around 2014: 2013: Belgium and the United Kingdom / 2014: Bulgaria, the Czech Republic, Estonia, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland and Sweden / 2015: Denmark, Germany, Ireland, Italy, Iceland and Norway. As the second wave covers all EU member states, this report deals only with EHIS data 2013-2015.

The recommended data collection mode are personal face-to-face interviews, but actually a great variety of other methods was also possible (telephone survey, computer-assisted personal interviews or self-administered questionnaires etc.). The minimum sample for the EU-28 is about 195000, the national minimum sample size ranges from 4000 for the smallest countries to about 15000 for Germany.

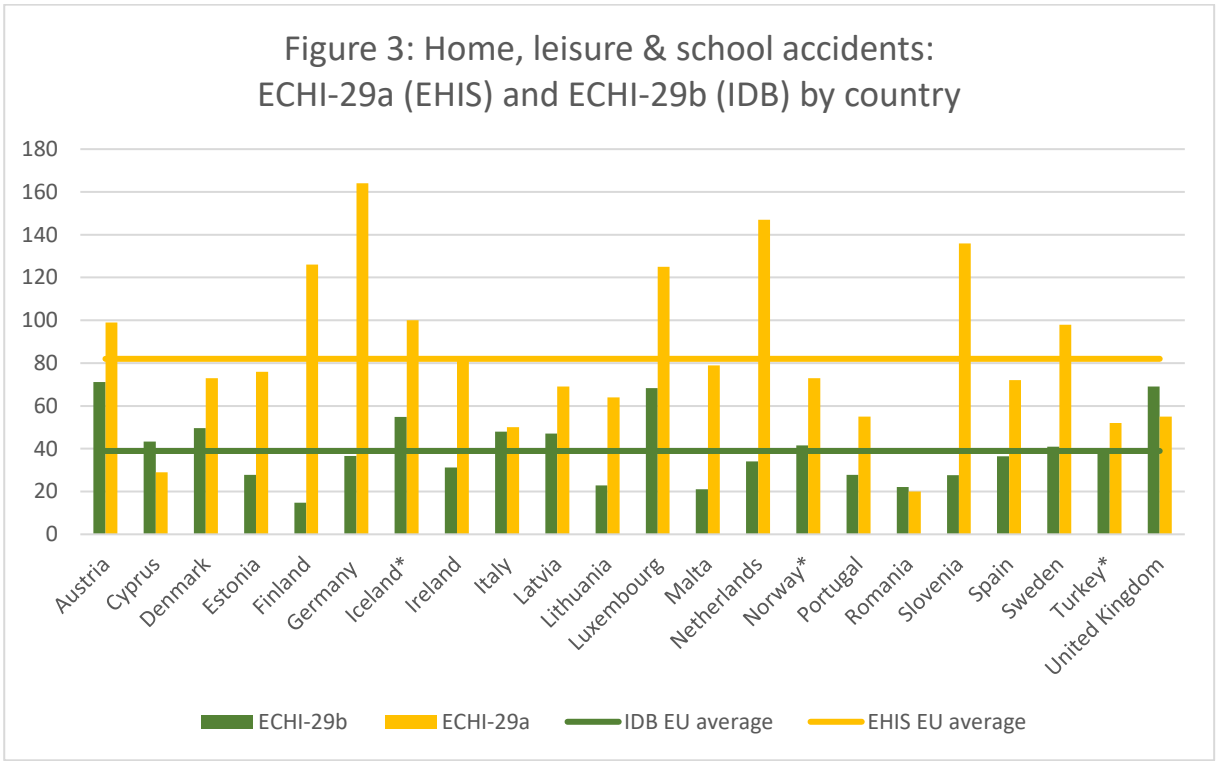
While IDB data are primly on the use of specific health services, i.e. ED attendances for injury diagnosis & treatment, EHIS data are primly on self-perceived morbidity, i.e. the incidence of an injury event in past 12 months. Table 3 shows the EHIS incidence rates and the IDB presentation rates (per 1000 inhabitants).

Neither Eurostat [19] nor the ECHI web-gate [5] display all actually recorded EHIS-indicators. Not available are: Rates for *all* accidents and work-place accidents, at least not in a comparable measurement: ECHI-31 is

defined as incidence rates per 10000 employees, not per *inhabitants*. Furthermore, a work-place accident is defined as absence from work of at least 4 calendar days, in contrast to the other indicators, which are given as ED (hospital) treatment rate per 1000 inhabitants. As there is no additional information (on place of treatment and employment status available, it is not possible to identify overlapping cases and to compare the two measurements [20].

Quantitative comparison EHIS-HLA and EHIS-Road with IDB

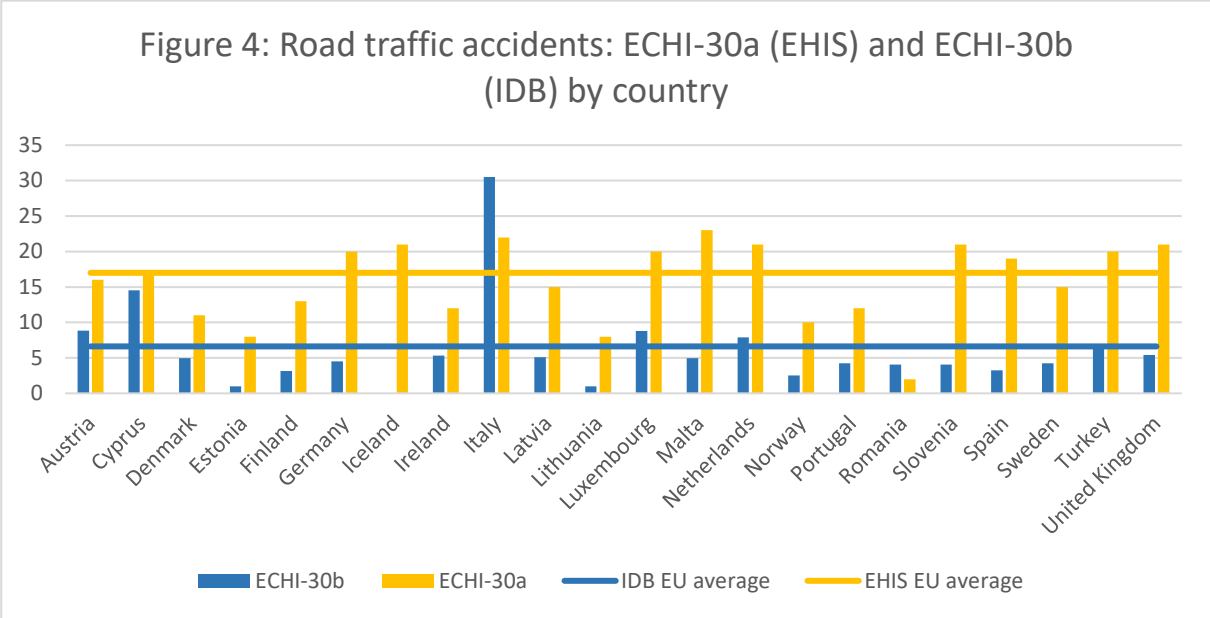
Comparable are only home, leisure and school accidents (EHIS based ECHI-29a vs. IDB based ECHI-29b) and road traffic accidents (EHIS based ECHI-30a vs. corresponding IDB rate). These results are presented in Figures 3 and 4.



The EU average rate for ECHI-29b is 38.9 per 1000 inhabitants. The IDB rates range from 14.7‰ in Finland to 71.1‰ in Austria – a range factor of 4.8. A range factor of this size is not unusual when comparing national health statistics.

The EU average of the corresponding survey based indicator 29a “Home & leisure injuries: self-reported incidence” is 82‰ and considerably higher than ECHI-29b. It can be assumed that methodological differences, e.g. the inclusion of minor injuries in the EHIS survey, play an important role for this result.

Remarkable is the huge difference between minimum ECHI-29a (20‰ for Romania) and the maximum (164‰ for Germany). It seems hardly possible, that the actual rate for road traffic injuries in one European country is 8.2 times higher than in another one. This is a surprising result, as with a view to the highly harmonized methodology of EHIS you would expect *less* variation than for IDB, where several sampling issues are known. For the time being, the reasons are unknown.



For non-fatal road injuries (ECHI-30b), the ECHIM project [6] originally mentioned police reports as the preferred data source, however it seems that these data are not available anymore; the annual ERSO report for 2016 analyses just fatalities and refers to the IDB estimates for non-fatal road traffic injuries [21]. Therefore, we propose IDB as alternative source for ECHI-30b.

The EU average of an IDB based ECHI-30b ("road traffic accidents: register based incidence") is 6.6‰ of the population, and the national estimates range from 1.0‰ in Lithuania to 30.5‰ in Italy. The IDB based ECHI-30b shows a remarkable high rate for Italy and noticeable low rates for Estonia and Lithuania. It is almost impossible, that these figures depict true morbidity. For Italy it seems that road traffic accidents get over-estimated due to the inclusion of records from emergency transport services, but this needs further clarification.

The average ECHI 30a ("Road traffic injuries: Self-reported incidence"), based on EHIS 2014 [19], is 17‰, which is considerably higher than the average for ECHI-30b with 6.6‰. The minimum incidence is 0.2‰ for Romania, and 2.3‰ for Malta. As it can be assumed that methodological differences are the main causes for the great variation of rates, the characteristics of the systems get explored in the following chapter.

<u>Different characteristics EHIS-IDB</u>

For two major sub-groups of injuries, the EHIS-rates are more than double the IDB rates. Although both systems report seemingly the same, due to different case definitions and scopes, large parts of reported cases do not overlap. Table 4 shows the main differences between these two systems (mainly based on the two metadata).

Table 4: Template for assessing differences between EHIS and IDB

	EHIS / injuries	IDB-MDS
General characteristics		
Processed at EU level	Eurostat	DG Santé
Underlying dimensions	1) Morbidity, 2) Health services	1) Health services, 2) Morbidity
Legal obligation	Gentlemen's agreement, based on Regulation 1338/2008	Gentlemen's agreement, based on Regulation 1338/2008 and Council Recommendation 2007/C164
Method	Household-survey with varying methodologies (face-to-face, telephone interview etc.)	Registration of treatments in hospital EDs with varying methods (face-to-

		face, extraction from other data sources etc.)
Standards	EHIS Methodological Manual, Metadata	IDB Operating Manual, Metadata
Scope		
Unit	Self-reported accident leading to injury (just accidents)	Medically diagnosed acute injury
Scope of severity	Every noteworthy case, including treatments in primary health care and cases without medical consultation	Only hospital treated cases (ambulatory or admitted)
Domains of prevention	Road, home, leisure accidents	All accidents, also school, interpersonal violence and deliberate self-harm)
Age-groups	Only 15+ (no children)	All ages
Population	Only residents	Residents + non-residents
Household	Only private households	All patients
Biases and accuracy		
Ability for interview	Under-coverage of mentally handicapped persons (e.g. suffering from dementia)	Unlikely (data recorded as part of anamnesis)
Refusals	1) Refusal of interview easy, 2) deliberate not-reporting of events is easy	Unlikely (data recorded as part of anamnesis)
Recall-Biases	1) Less impressive cases can easily be forgotten, 2) Severe cases can get reported, even when older than 12 months	Unlikely (data recorded immediately after event)
External biases	Unlikely	Accessibility to EDs and hospitals (particularities of national health care systems) plays an important role
Representativeness	Yes, due to well stratified sample	Yes, for countries with large samples of hospitals, questionable for countries with small samples of hospitals
Sample size	Rather small due to high costs per case (large samples of contacts needed for filtering out sufficiently large numbers of persons reporting an injury)	Rather large: records are a by-product of administration of treatments, costs per case are rather low
Accuracy of estimates	Sufficient for estimates on big subgroups	Sufficient also for estimates on smaller subgroups
Usability		
Public access points	Eurostat, ECHI web-gate	IDB web-gate, ECHI web-gate
International comparability	Yes	Limited regarding morbidity
Comparability with other groups of diseases	Yes	Theoretically yes, but not within IDB
Details on injuries	Just road traffic, home, leisure accident	Intent, type of injury, injured body-part, injury mechanism, activity, place of occurrence
Options for analyses	Pre-packaged tables (ECHI web-gate)	Free selection of subgroups by all IDB-MDS data elements (IDB web-gate)
Additional information on patients	General health status, health related behaviour, income, labour status, educational level, degree of urbanization etc.	No
Actuality	Every five years (most recent around 2014)	Continuous registration, annual update (most recent 2016)
Geo-coverage	2014: All EU MS + Iceland, Norway	2013: 19 EU MS + Iceland, Norway, Turkey

Certainly, the greatest impact has the fact, that EHIS records also not-treated injuries and injuries treated just in primary health care facilities; these less severe cases may outnumber the cases treated in hospitals.

However, restrictions of the scope (no work-place or school accidents, no acts of violence or deliberate self-harm, no children, no institutionalised individuals, no foreigners) again reduce the totals.

Further analysis on more harmonised case definition: pilot in two countries

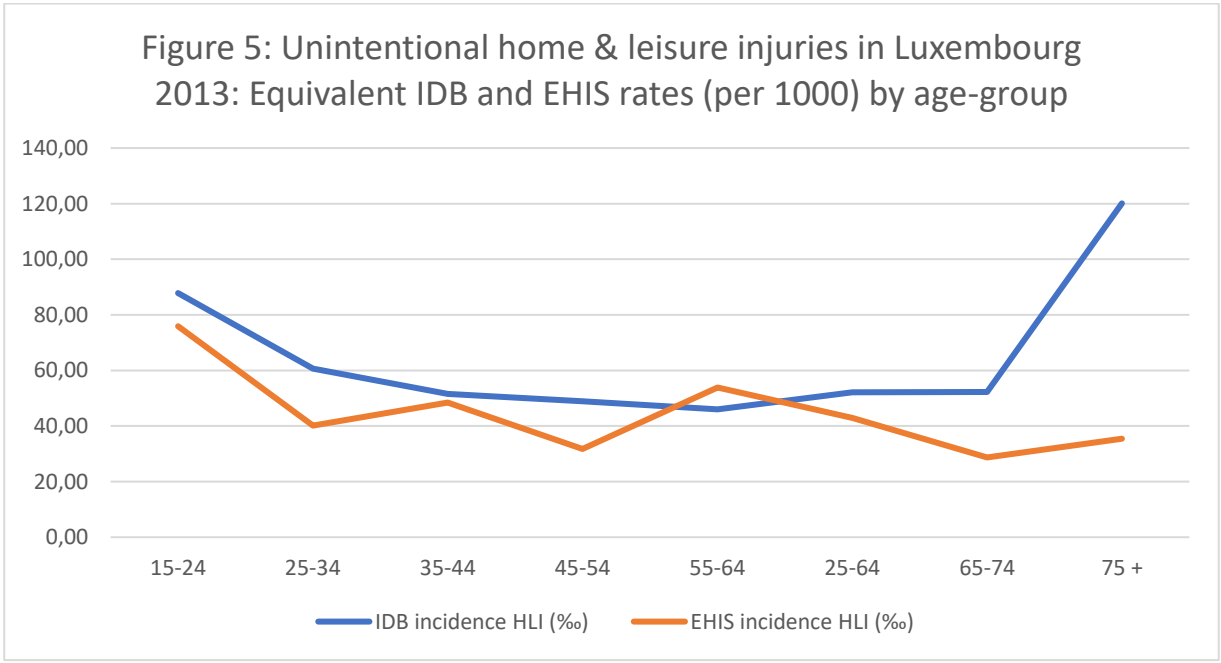
In principle it is possible to compare EHIS and IDB estimates for the overlapping groups. For an approximation one can select:

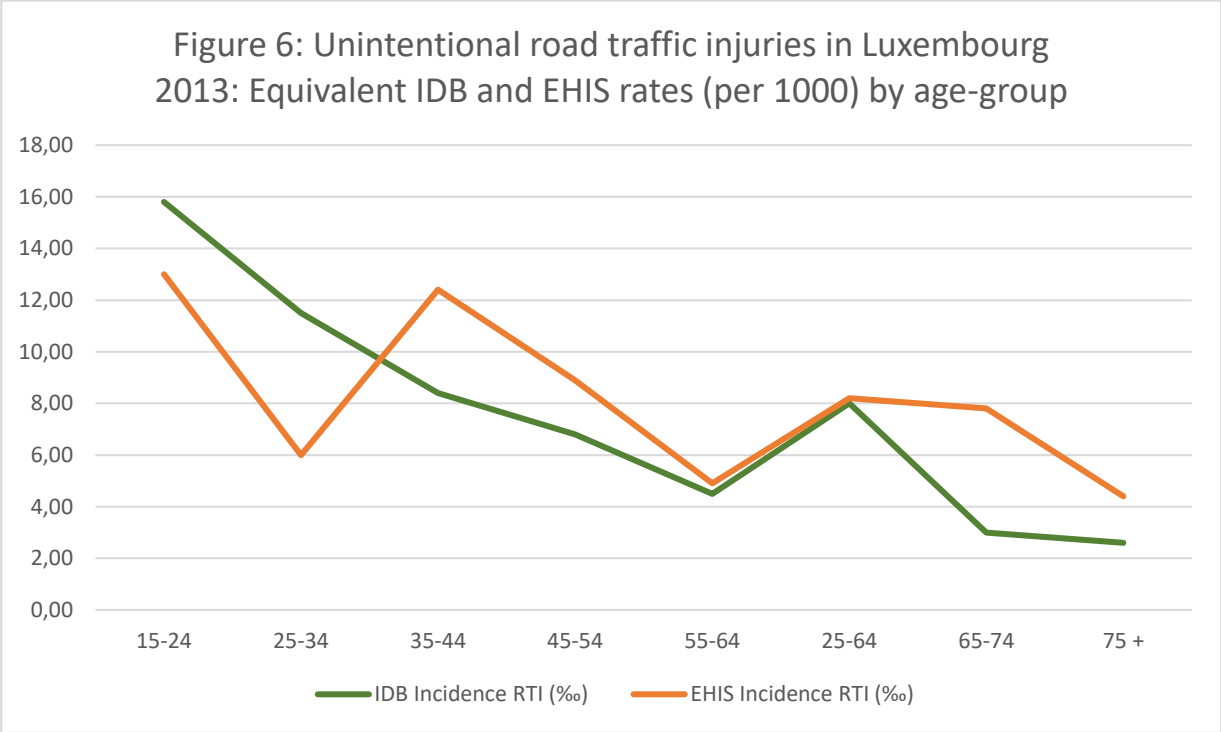
- from IDB cases: home and leisure accidents, road and work-place accidents, age-group 15+, residents only, and
- from EHIS cases: all cases "admitted to a hospital" (with or without stay overnight)

The IDB data for the age-group 15+ can be retrieved from the IDB public access [4], but the selection of EHIS cases which were treated in hospitals, is not possible through the public access to EHIS, and need access to the microdata. There are also no rates for work-place accidents *per inhabitants* publicly available, only *per workers*. Recognized research organization can apply for sets of anonymized EHIS records at the Eurostat web-gate [22], but unfortunately, this was not possible in the given framework due to limitations in capacities, time and legal status.

In order to explore, how close estimated rates from EHIS and IDB for overlapping population actually are, two exemplary studies were carried out, one in Luxembourg (Dritan et al. 2017; see annex 1 of this report) and another one in Denmark (Laursen et al 2016; see annex 2 of this report).

Main results from Luxembourg for home & leisure and road traffic accidents are shown in Figure 5 and 6.





In the study from Luxembourg, estimates from the household-survey EHIS and the IDB register are rather similar, when the same cases are selected (hospital treatments, home & leisure and road accidents, residents, age-group 15+).

The study in Denmark analysed just home & leisure accidents and reported an EHIS rate for ED treatments of 58‰ and an IDB rate of 99‰. However, the Danish study took also in consideration when the injury was factually treated, and 36% of the injuries reported in the household survey were actually treated longer ago than 12 months. This indicates that there are substantial recall biases toward severe cases. Minor injuries tend to get forgotten, while severe injuries tend to be reported even after a long time. These two recall biases work in opposite directions, eventually leading to general rates which are similar to the register based rated, but with a higher percentage of admissions.

A second important result is that household-surveys obviously underestimate the injury risk of old persons. Together with the fact, that there are no data on children, the lack of (valid) information on the injury risk of the most vulnerable age-groups is certainly a severe shortcoming.

Bejko et al. [23] as well as Laursen et al. [24] report a tendency of surveys to overestimate the share of admissions (tendency to report more severe injuries). In Denmark, the rate for admissions according to EHIS is 1.3% and the one according to IDB 0.7%. The data from Denmark show a strong recall bias toward severe injuries: only 63% of the cases were factually treated during the last 12 months.

Preliminary conclusions as to IDB estimates compared with survey data

The range (variation) of national rates in both systems is so great, that it seems unlikely that differences are only caused by differences in morbidity. This is unexpected for the household system EHIS, which has been set up to eliminate the influence of national health care systems. Further investigations are needed to identify the causes, which eventually are related to national differences of survey implementation.

The different scopes of EHIS and IDB make a direct comparison of global rates pointless. Meaningful is to compare the rates only for equivalent subsets of cases, i.e. the age-group 15+, only hospital treated cases,

only road traffic accidents and/or home & leisure accidents. The findings from two countries indicates that these rates for equivalent sub-groups can turn out rather similar. However, the percentage of admissions get overestimated in surveys, obviously due to recall biases which lead to an over-reporting of severe cases an underreporting of less severe ones. Further investigations are needed to better understand, how the different methodologies affect measurements.

The qualitative comparison leads to the conclusion, that both systems are indispensable: IDB deliver much more information on details of injuries and circumstances, which is needed for targeted prevention, and delvers also information on the most vulnerable group of children. On the other hand, EHIS deliver information on less severe injuries, which are not treated in hospitals. Combining the information of both systems plus mortality statistics provides a comprehensive picture of the health burden of injury, which covers deaths, severe and minor injuries.

5. Conclusions and recommendations

When an estimation of IDB based rates is necessary by using HDRs as reference statistics, as it is the case for many countries, it is essential to apply the same criteria for inclusion/exclusion of cases. Particularly non-residents, follow-up treatments, consequences of medical interventions, sequelae of injuries, day-patients and deceased patients shall be excluded on both sides before making projections based on the HDR method. When this is ensured, IDB based estimates are valid indicators on the health burden of injury and can be used e.g. for ECHI indicators.

It is recommended that IDB data get recorded in *all* hospitals across the country and for every ED patient treated for injury. This is already achieved for some countries. For these countries the question of accuracy and validity do not matter anymore.

While comparing IDB based rates *between* countries one should take into account that these rates reflect also specifics of the respective health care systems in place. A most influential factor is the actual accessibility of EDs, which differ substantially between countries. IDB based rates are strictly speaking no indicators for morbidity, but for injury related health care services and costs of hospital services, excluding the primary care costs.

For getting internationally comparable morbidity indicators, also on injuries, EU systems of household surveys have been implemented: the European Health Information System (EHIS). Unfortunately, the variation in EHIS based national injury rates between countries is so great, that it is unlikely that it is only caused by differences of injury morbidity. It must be assumed that other differences, e.g. of the national applications of the theoretically standardized methodology causes these differences.

The currently observed variation of estimated national rates within the given data collection systems shall not lead to the conclusion that these surveillance systems do not fulfil their purpose. Even biased data can be extremely useful at national level as long as the framework conditions do not change. Moreover, it should be considered, that only the visibility of these differences, which indicate shortcomings in national implementations, provides the basis for further improvements.

Both systems, EHIS and IDB have specific strengths and serve different information needs. EHIS based indicators allow to estimate *all* events leading to a (suspected) injury, including those which are not medically treated but severe enough to be reported by respondents and those which are treated by nurses and general practitioners, while IDB comprises only treatments in EDs, i.e. secondary health care facilities. EHIS figures can be compared with other diseases, which is not possible for IDB data. Therefore, EHIS based rates are much higher than IDB rates due to the different scope of the two surveillance systems, particularly the inclusion of minor injuries.

On the other hand, IDB data focus on the more severe injuries, i.e. treated in secondary care facilities, and provides much greater inner differentiation regarding type of injury, mechanism leading to injury, affected body part, activity carried out when injuries, and place of occurrence.

Preliminary analyses of EHIS (survey) based rates and IDB (register) based rates indicates that surveys lead to underreporting of injuries 65+. Together with the fact, that survey do not cover children, EHIS do not provide useful information of injury risks of the most vulnerable groups.

For comparing the rates, it is essential to apply the same criteria for inclusion/exclusion of cases and to deal only with overlapping scope: ED treatments and admissions, age-group 15+, only accidents (no violence or self-harm). When this is ensured, both systems seem to deliver rates, which are at least within reasonable margins.

There are different information needs within the public health sector, which cannot get fully met solely by one or the other injury surveillance system. For a complete picture on the health burden of injury, including minor injuries treated outside hospitals, also EHIS data is needed. For developing priorities for prevention, for guiding targeted actions and for evaluating actions of different political sectors, IDB data is needed.

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Annex 1: Paper, submitted for publication

"To survey or to register" is that the question for estimating population incidence of injuries?

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Introduction

Measuring the true incidence of injury or medically attended injury is challenging. Population surveys, despite problems with recall and selection bias, remain the only source of information for injury incidence calculation in many countries. Emergency department (ED) registry based data provide an alternative source. The aim of this study was to compare the yearly incidence of hospital treated Home and Leisure injuries (HLI), and Road Traffic Injuries (RTI) estimated by survey-based and register-based methods.

Methods

Data from Luxemburg's European Health Examination Survey (EHES), European Health Interview Survey (EHIS) and from ED surveillance system Injury Data Base (IDB) collected in 2013, were used. EHES data on 1,529 residents 25-64 years old, were collected between February 2013 - January 2015. EHIS data on 4,004 other residents aged 15+ years old, were collected between February 2014 and December 2014. Participants reported last year's injuries at home, leisure and traffic and treatment received. Two-sided exact binomial tests were used to compare incidences from registry with the incidences of each survey. This project was part of the European Union project BRIDGE-Health (BRidging Information and Data Generation for Evidence-based Health Policy and Research) .

Results

Among 25-64 years old the incidence of hospital treated injuries per thousand population was 60.1 (95%CI: 59.2-60.9) according to IDB, 62.1 (95%CI: 50.6-75.4) according to EHES and 53.2 (95%CI: 45.0-62.4) according to EHIS. The incidence of hospital admissions was 3.7 (95%CI: 3.5-4.0) per thousand population from IDB-Luxembourg, 12.4 (95%CI: 7.5-19.3) from EHES and 18.0 (95%CI: 13.3-23.8) from EHIS. For 15+ years-old incidence of hospital treated HLI is 62.8 (95%CI: 62.1-63.5) per thousand population according to IDB whereas the corresponding EHIS estimate is significantly lower at 46.9 (95%CI: 40.4-54.0).

Discussion

The overall incidence estimate of hospital treated injuries from both methods does not differ significantly for the 25-64 years old. Surveys overestimate the number of hospital admissions, probably due to telescoping bias. For people aged 15+ years, the survey estimate is lower than the register estimate for hospital treated HLI injuries, probably due to selection and recall biases. EDR based registry data is to be preferred as single source for estimating the incidence of hospital treated injuries in all age groups.

Introduction

Injury is the fourth leading cause of mortality in the general population and the leading cause for children above one year and adults to 44 years (1). In order to estimate burden of injuries, set-up priorities, target groups at higher risk for prevention activities and evaluate the effects of preventive actions, decision makers need information about the incidence of both fatal and non-fatal injuries.

For injury mortality death certificate data are commonly used, however, the method of collecting information on non-fatal injuries varies from country to country. Hospital treated injuries are best estimated using Emergency Department's Registry (EDR) based data(2). National Hospital Discharge Registries (HDR) are also a valuable source of information (3, 4) especially if EDR are not available from a representative sample of hospitals. Although data on specific injuries, like road traffic or work-related injuries, are collected from other organisations outside the health sector, information on the majority of out of hospital treated or untreated injuries can only be collected through surveys. In some countries surveys remain the only source of information for hospital treated injuries.

Understanding factors related to the method of data collection is crucial in accurately estimating non-fatal injury incidence and burden. Comparisons between surveys and EDR data have previously been reported but the approaches were so heterogenous that the authors concluded that the results from the two methods were uncomparable (5). One study compared a sample of cases receiving treatment for injury in a limited number of EDs, with a representative sample of the population from a survey and reported lower injury incidence in the survey (5, 6). EDR injury data collection based only on reference trauma centers has been shown to underestimate incidence of road traffic or work-related injuries compared to other sources of data(7, 8).

Taking advantage of the small size of Luxembourg this study provides a unique opportunity to compare national estimates of non-fatal injury incidence using data collected from all emergency departments of all hospitals in one year with survey based data from two representative samples of residents covering approximately the same period of time.

The aim was to compare the population incidence of hospital treated home and leisure and road traffic injuries estimated by survey-based and register-based methods and create an injury incidence pyramid from all sources of information.

Methods

Cross-sectional population-based survey data from the European Health Examination Survey (EHES) and European Health Interview Survey (EHIS) in Luxembourg and data from the Luxemburg IDB system were used. Both EHES and EHIS methodology followed international protocols(9).

EHES data on 1,529 residents 25-64 years old, were collected between February 2013 and January 2015(10). Participants were asked separate questions about the previous twelve month's injuries at home; during leisure activities; at work; about RTI while commuting to work and non-work related RTIs. From respondents declaring any injury, information was collected on treatment received with the following answer options: admitted and stayed overnight in hospital; admitted but did not stay overnight in hospital; treated by a doctor or nurse outside the hospital; and no consultation or intervention was necessary.

EHIS data on 4,004 other residents ≥15 years old, of whom 2,794 aged 25-65 years old, was collected between February 2014 and December 2014. Participants were asked in three separate questions if they had injuries at home, during leisure activities or from road traffic during the previous year (11). Information on treatment received for the most severe injury was collected using the same answer options as for EHES.

Registry data from the Luxembourg ED injury surveillance system in 2013 was used for comparison. The common European Injury Data Base (IDB) methodology is used by IDB-Luxembourg(12). Injury cases are selected based on reason of the visit registered by a nurse at ED's triage or if at least one International Classification of Diseases (ICD-10) code of injury is used by the medical doctor. In hospitals that were using

a paper and pencil system, files of all ED patients were reviewed, injury cases were selected and coded by a data entry clerk. Monitoring visits on randomly selected weekdays and weekends were performed in all EDs to check for completeness according to the World's Health Organization methodology(13). Finally, narratives extracted together with injury data were reviewed, to exclude non-cases and validate the data. After a pilot phase launched in 2012, all nine EDs regrouped in five hospitals in Luxembourg participated in IDB-Luxembourg in 2013.

As per IDB-Network methodology a detailed set of information called the Full Data Set (FDS) is collected in one hospital. All other hospitals collect less detailed information corresponding to the IDB-Minimum Data Set (MDS). Only first visits for an injury were considered as a case and non-residents were excluded from the calculations. Both FDS and MDS include items, such as, intent (accident, self-harm or violence) activity (sport, paid work) place of occurrence (home, school, road) and mechanism (fall,burn, road traffic injury,etc). Combining information from different fields makes it possible to classify injuries according to prevention domains. Road Traffic Injuries are all injuries for which the mechanism is a road traffic accident, including while commuting to work. The home and leisure injury group includes all unintentional injuries excluding those from road traffic, occupational exposures and occurring in schools (14). Given the definition of leisure time injuries in the surveys injuries classified as due to sports from IDB were also included in the home and leisure category.

For comparative reasons with EHIS work and non-work related road traffic injuries from EHES were regrouped into the RTI group and only the most serious medical care intervention for the most serious injury event was considered for incidence calculation. Home and leisure time accidents were combined into Home and Leisure injuries (HLI).

For IDB-Luxembourg incidence was calculated by dividing the number of cases registered in IDB-Luxembourg for the specific age groups and prevention domain by the total number of residents of that age group, as recorded in the official statistics of 2013. For surveys, incidence was calculated by dividing the number of participants reporting receiving medical treatment in hospitals for a specific age-group and prevention domain by the total number of participants of the same age-group. Non-responses to questions about the previous year's injuries were excluded from calculation. For the surveys and the registry, 95% confidence intervals (95%CI) were calculated. The annual incidence estimates from the IDB registry were considered as true population data for 2013. Two-sided exact binomial test was used to compare incidences of IDB versus EHES, and IDB versus EHIS. For surveys estimates both weighted and unweighted data were presented but conclusions were based only on the weighted estimates.

EHES and IDB-Luxembourg had received prior ethical approval from Luxembourg's National Ethic's Comitte, the Comite National d'Ethique de Recherche (CNER). According to national regulation and responding to the european obligation to collect EHIS data the CNER was informed by Luxembourg's Ministry of Health in charge of EHIS. All survey participants signed a prior informed consent. Only anonymous unlinkable data were included in IDB-Luxembourg and in EHIS. Information about EHES, EHIS and IDB-Luxembourg was sent to the Nationnal Data Protection Comittte prior to data collection. This work comprised part of the methodological development work on injury surveillance for the EU funded BRIDGE-Health (BRidging Information and Data Generation for Evidence-based Health Policy and Research) project.

Results

A total of 65,401 injury cases were registered in IDB-Luxembourg in 2013. There were 18,347 residents aged 25-64 years old that received medical care in one of the hospitals of the country because of a HLI or RTI. Among them 1,142 (6.2%) were hospitalised (Figure 1). The total number of HLI and RTI among the 15+ year old residents was 31,664 and among these 2,935 (9.3%) had an overnight stay in hospital.

Among 3,864 EHIS participants aged 15+ years that responded to the injury questions, 469 reported an injury last year of whom 67 were admitted and stayed overnight, 145 were treated in hospital's ED as outpatients, and 123 received medical care outside hospital. Focusing on 25-64 years old the corresponding

figures were 316 injuries reported, 50 inpatients and 95 outpatients from 2794 respondents. Finally, among 1,528 EHES participants that responded to injury questions, 174 had at least one injury last year, 19 were hospitalised and 73 were treated as outpatients.

The incidence of hospital treated road traffic injuries among 25-64 years old was 8.0 ‰ population (95%CI: 7.7-8.3) according to IDB, 8.5‰ (95%CI: 4.5-14.5) according to EHES and 8.6‰ (95%CI: 5.5-12.9) according to EHIS (Table 1). Among 15+ years the corresponding figure were 8.3 ‰ (95%CI: 8.0-8.5) for IDB and 8.8 ‰ (95%CI: 6.1-12.3) according to EHIS.

The incidence of hospital treated Home and Leisure injuries among 25-64 years old was 52.1‰ (95%CI: 51.3-52.9) according to IDB, 53.6‰ (95%CI: 42.9-66.1) according to EHES and 43.9‰ (95%CI: 36.4-52.3) according to EHIS (Table 1). Among 15+ years the corresponding figures were 62.8 ‰ (95%CI: 62.1-63.5) according to IDB and 46.9‰ (95%CI: 40.4-54.0) according to EHIS. There was no significant difference between each survey and IDB-Luxembourg in estimating Incidence of hospital treated RTI or HLI among 25-64 years old.

The incidence of hospital admissions for RTI was 0.8‰ (95%CI: 0.7-0.9) from IDB, 1.3‰ (95%CI; 0.2-4.7) from EHES and 3.7‰ (95%CI; 1.8-6.9) from EHIS (Figure 2). The incidence of hospital admissions due to Home and Leisure injuries was 2.9‰ (95%CI; 2.8-3.1) from IDB, 11.1‰ (95%CI: 6.5-17.7) from EHES and 13.9‰ (95%CI; 9.8-19.1) from EHIS (Table 2). The incidence of hospital admisions for HLI is overestimated by both surveys and EHIS overestimates also hospital admisions for RTI ($p<0.001$). It should be noted that for the age-group 25-64 years old EHIS overestimates incidence of hospital admissions, underestimates incidence of hospital outpatients but when it comes to overall hospital treated injuries EHIS estimate does not differ significantly from IDB's estimate (Figure 2).

According to IDB data, incidence of hospital treated HLI injuries shows two peaks (Figure 3), one among the 15-24 years old with 87.8 (95%CI: 85.6-90.0) per 1000 population and another among those 75+ years with 120.1 (95%CI: 116.7-123.5) per 1000. EHIS estimates an incidence of HLI among 15-24 years old of 72.9 ‰ (95%CI; 53.1-97.3) that is not different from IDB (p-value =0.09). For people aged 65 years or older EHIS significantly underestimates incidence of hospital treated HLI (35.5 vs 84.5; p-value <0.001) . The difference is more accentuated among the 75+ years old with an estimate of 39.0 per 1000 population, about three folds lower than the 120.1 per 1000 population IDB estimate (p-value <0.001). On the other hand there is no difference in estimating Incidence of RTI between EHIS and IDB in any of the above mentioned age groups (Table 1).

For the age group 25-64 years old we can estimate from the surveys that for HLI and RTI about 45.6% of injured cases will receive a medical treatment in a hospital. Knowing the share of inpatients among hospital treated injuries from IDB data and the share of non-treated injuries from surveys enables an injury burden pyramid to be constructed for 2013 (Figure 4).

Discussion

For people aged between 25 and 64 years the overall incidence estimate of hospital treated injuries from surveys and ED based registries is similar and does not differ significantly but the incidence of hospital admissions is overestimated by both surveys. EDR based data shows an increase in HLI incidence from age 65 which is more emphasized from 75+ years. This increase is not shown in EHIS survey data that significantly underestimates incidence of hospital treated HLI injuries for this age group. For all participants (>15 years old incidence of hospital treated HLI is underestimated by EHIS survey (46.9‰ population, 95% CI: 40.4-54.0) when compared to register based estimates (62.8 ‰, 95% CI: 62.1-63.5)). As concluded in other studies (15-17) with only about half of all injuries treated in hospitals, the combination of both data sources provides better estimates of injury incidence but is limited in scope to selected age groups and types of injury. Although cross sectional surveys provide information on potential risk factors there are inherent limitations in survey data for getting a deeper insight in determinants of injuries and their consequences. For that purposes, ED

based injury surveillance systems, that collect in a cost effective way detailed information on a large number of cases are indispensable

Overreporting of hospitalisations from survey is also reported from other studies and is due to the so called telescoping bias. Events like being hospitalised for an injury are brought forward in time by the responder although they have happened more than a year ago. In a Danish study data from National Health Interview Survey participants were linked at individual level with Hospital EDR and HDR data(17). For some cases no EDR evidence of hospital treated injuries among survey participants declaring they had an injury was found. On the other hand EDR evidence of injury among survey participants declaring they had not sustained an injury was reported. Overall, due to a combination of telescoping and recall bias no difference between surveys and ED based registries in estimating hospital treated injury incidence and an overestimation of hospital admissions by the survey was found.

Many studies report about difficulties that elderly people have to recall falls, especially for a 12 months recall period although falls causing injuries are less likely to be forgotten(18, 19). It should be noted that in 2013 about 80% of injuries registered in IDB-Luxembourg among +70 years old were due to falls(1).

Selection bias is not excluded given that for people older than 65 years the EHIS participants are not representative of the reference population. As a matter of fact, people from residential institutions, like nursing homes, homes for elderly, were excluded from the EHIS sampling frame. This would have a limited effect for the age group 65 -75 years old given that more than 95% of people live in their private homes. However the proportion of people living in homes for elderly increases with age from 10% for the 80 years old to 40% for the 90 years old(20). Although responders are representative of Luxembourg's population on sex, age, and district of residence, a participation rate of 25% for the surveys might also be a source of selection bias. Underestimation by surveys of injuries among 65+ years old has been reported elsewhere as well(6). It should be underlined that a selection bias due to referral system, like only in trauma centers based registries, is excluded given that all ED of all hospitals were included in IDB-Luxembourg in 2013(7).

Finally EHIS participants only had the possibility to report one hospital treated injury per year whereas in IDB all hospital treated injures of one particular person were counted as separate injury cases. The anonymous unlinkabel nature of IDB-Luxembourg data does not allow to see if one person has more than one hospital treated injury per year. This might have an effect on underestimating incidence from the surveys. It is reported that about 11% of nursing home residents + 70 years report more than one fall for the previous year(21).

Conclusions

In absence of ED based injury surveillance systems covering a representative sample of hospitals, for people aged 25-64 years old surveys provide a valid estimate of hospital treated HLI and RTI but overestimate the the number of hospital admissions. Incidence of hospital treated HLI among people aged 65+ years and for all the age group of 15+years old will be underestimated by surveys. With only about half of injuries receiving medical care in hospitals, combining both methods gives a better estimate of injury burden although it is limited in only selected age groups and types of injury.

Figure 1 Flow chart with inclusion of injury cases for IDB Luxembourg, EHIS and EHES surveys

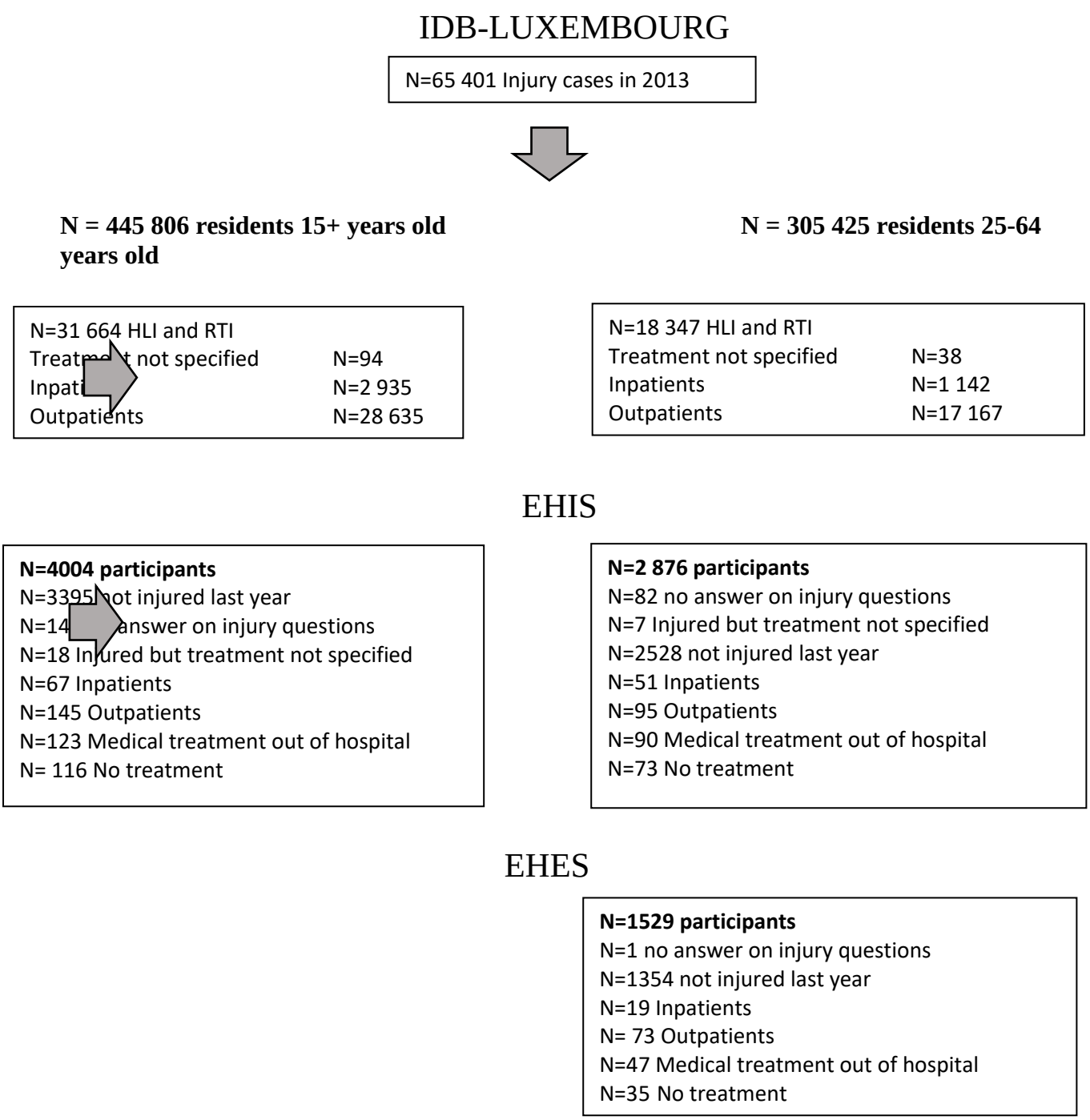


Table 1 Incidence of injuries per age group and prevention domain according to the different methods

IDB-Luxembourg	**15-24**	**25-34**	**35-44**	**45-54**	**55-64**	**25-64**	**CI 95%**		**65-74**	**75 +**	**15 +**	**CI 95%**	
Road Traffic Injuries (n)	1029	903	702	564	270	2439			117	94	3679		
Home and Leisure injuries (n)	5735	4778	4326	4048	2756	15908			2056	4286	27985		
Population at risk	65324	78671	84061	82761	59932	305425			39365	35692	445806		
Incidence RTI (‰)	15.8	11.5	8.4	6.8	4.5	8	7.7-8.3		3.0	2.6	8.3	8.0-8.5	
incidence HLI (‰)	87.8	60.7	51.5	48.9	46	52.1	51.3-52.9		52.2	120.1	62.8	62.1-63.5	
incidence RTI and HLI (‰)	103.5	72.2	59.8	55.7	50.5	60.1	59.2-60.9		55.2	122.7	71.0	70.2-71.8	
EHES								IDB vs EHES p-value					
Road Traffic Injuries (n)		4	5	2	2	13							
Home and Leisure injuries (n)		18	29	16	16	79							
Population at risk		314	461	461	292	1528							
Incidence RTI (‰)		12.7	10.8	4.3	6.8	8.5	4.5-14.5	0.77					
incidence HLI (‰)		57.3	62.9	34.7	54.8	51.7	41.1-64.0	1					
HLI+RTI (‰)		70.1	73.8	39.0	61.6	60.2	48.8-73.3	0.96					
Weighted													
Incidence RTI (‰)		12.9	9.2	4.9	6.7	8.5	4.5-14.5	0.77					
incidence HLI (‰)		62.0	64.7	34.0	53.9	53.6	42.9-66.1	0.79					
incidence RTI and HLI (‰)		74.9	74.1	38.8	60.6	62.1	50.6-75.4	0.74					
EHIS								IDB vs EHIS p-value					IDB vs EHIS p-value
Road Traffic Injuries (n)	6	4	9	7	3	23			3	1	33		
Home and Leisure injuries (n)	35	27	35	25	33	120			11	8	174		
RTI or HLI (n)	1	0	2	0	0	2			1	1	5		
Population at risk	461	672	723	786	613	2794			383	226	3864		
Incidence RTI (‰)	13.0	6	12.4	8.9	4.9	8.2	5.2-12.3	0.83	7.8	4.4	8.5	5.9-12.0	0.79
incidence HLI (‰)	75.9	40.2	48.4	31.8	53.8	42.9	35.7-51.1	0.03	28.7	35.4	45.0	38.7-52.1	<0.001
incidence RTI and HLI (‰)	91.1	46.1	63.6	40.7	58.7	51.9	44.0-60.8	0.07	39.2	44.2	54.9	47.9-62.5	<0.001
Weighted													
Incidence RTI (‰)	12.2	5.8	14.5	8.3	4	8.6	5.5-12.9	0.70	7.7	4.3	8.8	6.1-12.3	0.68
incidence HLI (‰)	72.9	42.2	50.2	31.9	53.8	43.9	36.4-52.3	0.054	33.4	39.0	46.9	40.4-54.0	<0.001
incidence RTI and HLI (‰)	88.5	48	67.4	40.3	57.8	53.2	45.0-62.4	0.13	43.7	47.6	57.2	50.1-65.0	<0.001

Table 2. Incidence of injuries, among the 25-64 years old, per prevention domain and treatment according to the different methods.

	Registry IDB			EHES				EHIS			
Hospital inpatients											
Unweighted	**n**	**Incidence ‰**	**(CI95%) ‰**	**n**	**Incidence**	**(CI95%) ‰**	**IDB vs EHES p-value***	**n**	**Incidence ‰**	**(CI95%) ‰**	**IDB vs EHIS p-value***
RTI	242	0.8	0.7-0.9	2	1.3	0.2-4.7	0.34	9	3.2	1.5-6.1	<0.001
HLI	900	2.9	2.8-3.1	17	11.1	6.5-17.8	<0.001	40	14.3	10.2-19.4	<0.001
RTI and HLI	1142	3.7	3.5-4.0	19	12.4	7.5-19.4	<0.001	50	17.9	13.3-23.5	<0.001
Weighted											
RTI					1.3	0.2-4.7	0.34		3.7	1.8-6.9	<0.001
HLI					11.1	6.5-17.7	<0.001		13.9	9.8-19.1	<0.001
RTI and HLI					12.4	7.5-19.3	<0.001		18	13.3-23.8	<0.001
Hospital outpatients											
Unweighted											
RTI	2191	7.2	6.9-7.5	11	7.2	3.6-12.8	0.88	14	5	2.7-8.4	0.21
HLI	14976	49	48.0-50.0	62	40.6	31.2-51.7	0.14	80	28.6	22.8-35.5	<0.001
RTI and HLI	17167	56.3	55.4-57.0	73	47.8	37.6-59.7	0.16	95	34	27.6-41.4	<0.001
Weighted											
RTI		7.2			7.2	3.6-12.8	0.88		5.2	2.9-8.8	0.22
HLI		49			42.5	33.0-53.9	0.24		30	23.8-37.2	<0.001
RTI and HLI		56.3			49.7	39.4-61.8	0.27		35.6	28.9-43.3	<0.001

***Exact Binomial Test**

Figure 2. Incidence (‰ population) of hospital treated injuries according to method of estimation and age-group

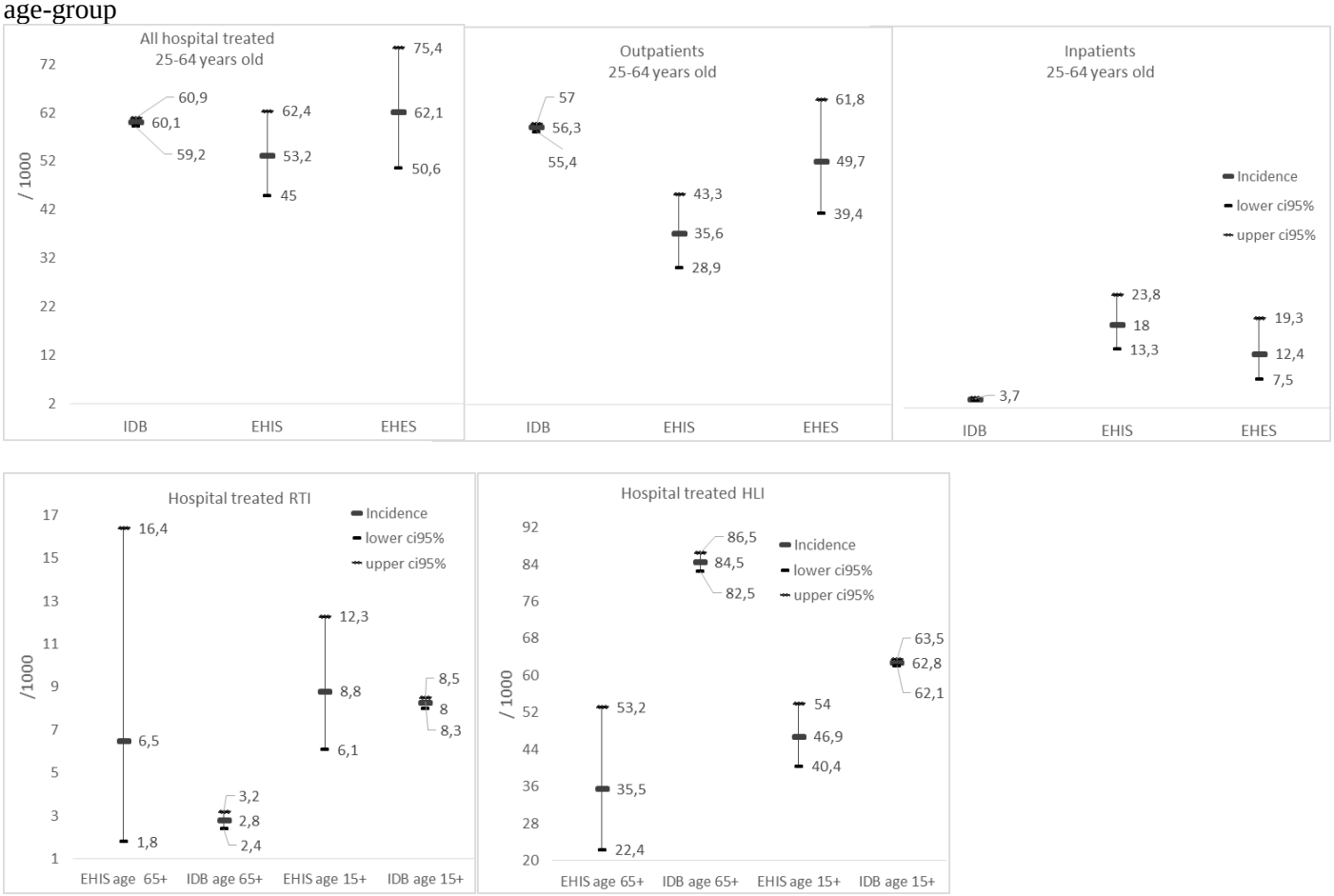


Figure 3. Incidence (‰ population) of hospitals treated HLI and RTI according to IDB-Luxembourg, EHES and EHIS surveys

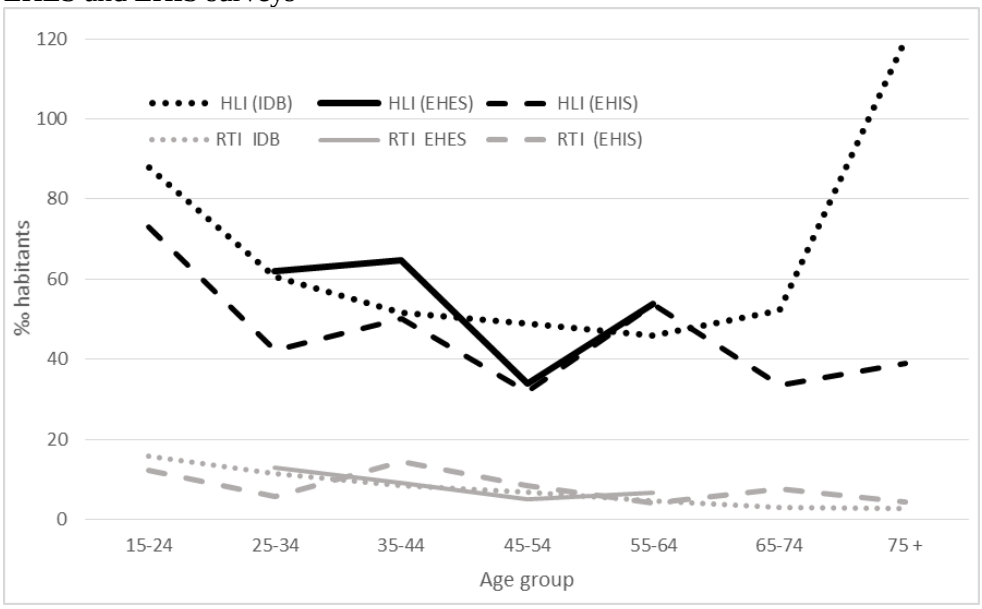
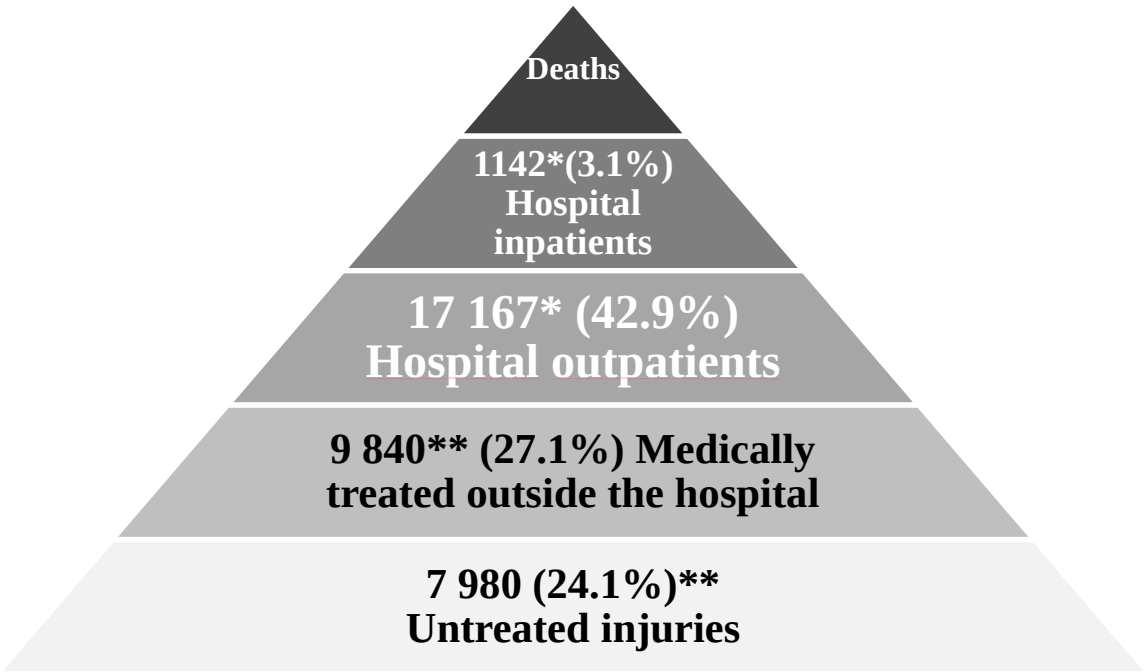


Figure 4. Injury pyramide for Home and Leisure injuries and road traffic accidents among 25-64 years old residents in Luxembourg in 2013



*Source IDB-Luxembourg
** Source EHIS/EHES survey

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Annex 2: Presentation given at the 12th world conference on injury prevention "Safety 2016" in Tampere, Finland, 20 September 2016

HOSPITAL REGISTRATIONS AND HEALTH SURVEY DATA – DO THEY AGREE?

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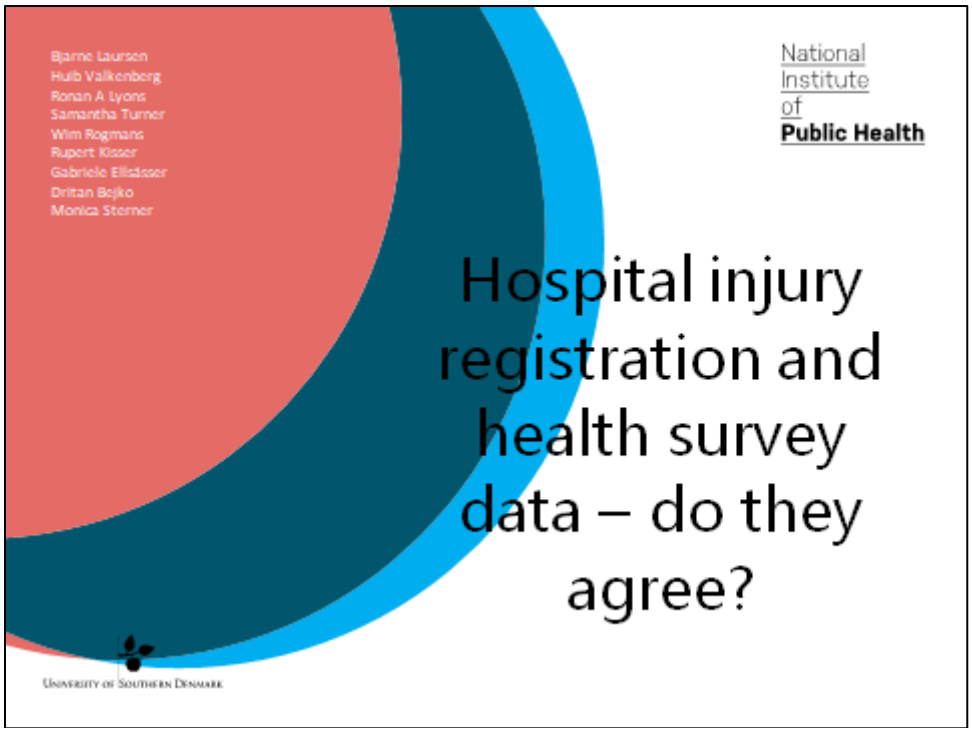
Background In many countries health interview survey data are used for indicators for injury incidence. However, the validity of self-reported injury incidence may be questioned due to e.g. recall bias and low response rate in groups at high injury risk. In the first European Health Interview Survey the incidence of home and leisure injuries varied as much as from 1.3% to 8.2%. The purpose of the present study is to compare survey response and hospital registration at the individual level with focus on reporting bias.

Methods This study was carried out using the Danish health interview survey data with information on injury the past year and the treatment. These data were linked at the individual level to the hospital registration of both in- and outpatient data for the period up to two years before the interview, for all hospitals in Denmark.

Results In total 368 reported injuries being hospital treated as outpatient, of these 234 were actually hospital treated within the last 12 months (64%). Ninety-six reported being admitted to hospital, of these 51 were actually admitted the past year (53%) and 59 the past two years (61%). Conversely, only about half of the hospital treated injuries were reported in the survey.

Conclusions There is considerable disagreement at the individual level between self-reported hospital treated injuries and actual hospital treatment. Hospital admissions in particular seem to be over reported.

Keywords Incidence, Indicator, Health interview survey.



Objective and methods

- The purpose was to compare results from hospital registration and survey answers for the same population
- Survey data on injuries was based on the Danish National Health Interview Survey in 2000 including 16,690 respondees aged 16+ (rate 74%)
- For these persons information on injury related hospital contacts were obtained from the National patient register

Results

- Survey results (prevalence)
  - 10.7 % sustained an leisure injury (affecting daily activities)
    - 1.3 % as inpatient
    - 5.0% as ED patient
    - 2.9 % by GP
    - 1.6 % elsewhere
    - 2.4 % not treated

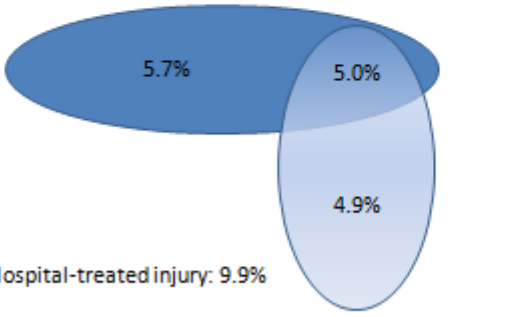
} total hospital treated: 5.8%

- Hospital data (NPR, incidence)
  - 9.9 % hospital treated for leisure injuries the last 12 months
    - 0.7% were admitted to hospital

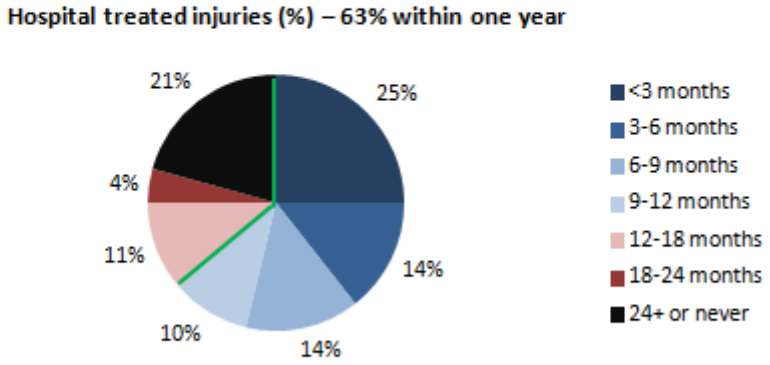
Survey and hospital registration - do they report the same injured persons?

N = 16,690

Survey: injury 10.7% - 5.8 % report hospital treatment



Person who report a *hospital treated* injury the last year: when were they hospital treated?



Key messages

Surveys and hospital data report different cases!
Survey:
+ Little dependence on health care system, consistent and known registration method (scientific purpose);
- Selection bias and recall bias

Hospital registration:
+No selection bias and no recall bias, larger N
- Depend on health care system; administrative registration