Sickness Absence among Passenger Car Occupants following a Crash

R. Elrud, H. Stigson, M. Ohlin, K. Alexanderson, L. Kjeldgård, E. Friberg

Abstract Sickness absence is a common consequence of road traffic crashes, with high costs for the individual and society. Yet, scarcely studied, therefore, the aim was to describe sickness absence among injured car occupants.

A population-based study using register data was conducted, including all car occupants of working age living in Sweden, who in 2010 had specialised in- or outpatient healthcare due to a car crash (n=9427). Individuals were categorised based on age, sex, and injury type. Odds ratios with 95% confidence intervals for a new sickness absence spell >14 days were estimated.

After excluding the 9% already on sickness absence or disability pension, 10% had a new sickness absence spell >14 days. Sex and crash type were not associated with new sickness absence, while old age and being born outside Europe were associated with higher odds ratios. Odds ratios varied with the type of injury and injured body region. The odds ratio for sickness absence was highest for injuries to the spine and spinal cord odds ratio: 8.64 (95% confidence interval 6.45-11.57). Traumatic brain injuries except concussion had an odds ratio of 6.99 (4.04-12.08) while concussions had an odds ratio of 2.66 (1.80-3.93).

Keywords car occupants, insurance medicine, sick leave, traffic accidents, traffic injuries

I. INTRODUCTION

The consequences of road traffic crashes have long been a matter of concern in many countries. Fatalities and injuries resulting from crashes impact public health as well as societal costs, and have received increasing attention from a wide range of stakeholders from government authorities to vehicle manufacturers. In many countries the actions taken have shown results. Within Europe, the number of road traffic fatalities has been reduced by 50% between 2001 and 2015 [1]. In Sweden, a country with one of the best levels of road safety, the fatalities due to road traffic crashes decreased by 66% between 1990 and 2015 [2]. However, the progress in reducing injuries during the same period has not been as successful (22% reduction). The cost of road traffic crashes stands for half of the total cost of all accidents in Sweden (EUR1.3 out of EUR2.3 billion in 2005) [3]. The main proportion (72%; around EUR0.9 billion), was due to productivity loss. With the decreasing number of fatalities, focus on the consequences of nonfatal injuries becomes more essential.

Temporary absence from work due to work incapacity caused by disease or injury is called different things in different countries and insurance systems, however, usually sickness absence (SA) or sick leave. Here we use the term SA. If the need for SA is assessed to be permanent, people instead can be granted disability pension (DP), in some countries called 'early pension on medical grounds' or 'incapacity benefits'. Research on SA or DP as a consequence of road traffic crashes are in most previous studies, focusing on *return to work* [e.g., 4-6]. Further, the outcome *return to work* has

R. Elrud (+46 8 524 832 24/rasmus.elrud@ki.se) and L. Kjeldgård are PhD students, E. Friberg is Assistant Professor, and K. Alexanderson is Professor, at the Division of Insurance Medicine, Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden. M. Ohlin is a PhD student at the Department of Food and Nutrition and Sport Science at the University of Gothenburg, Sweden. H. Stigson is Associate Professor at the Department of Applied Mechanics at Chalmers University of Technology, Sweden; Researcher at Folksam Research, Stockholm, Sweden, and associated to the Division of Insurance Medicine, Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden.

been measured and defined in many different ways. Very little is known or published about the related concept: SA among persons injured in road traffic crashes.

Research on this matter may expand the understanding of the consequences of such crashes, and aid in developing strategies and preventive measures to ultimately decrease SA among those injured. To the best of our knowledge, so far, only two studies that did not focus on one specific injury, used the outcome measure SA in relation to road traffic crashes including passenger cars. In one study it was found that among people seeking in- and outpatient healthcare at a hospital due to road traffic crashes, 66% of those entitled to compensation benefits became registered for SA [7]. In another study including 255 injured car occupants that were treated at a hospital emergency department it was found that 40% had SA after the crash [8]. Strain of the cervical spine accounted for 75% of the sick-leave days in this group. In these studies it was not clear if the patient was at risk of a new SA-spell, or if the injured individual was already on SA or DP. To ascertain an accurate measure of SA incidence, it is important to exclude those with already ongoing SA or DP of such grade that a new SA-spell is not possible. Another common limitation of studies of SA, and other outcome measures related to SA, in relation to traffic crashes, is the use of self-reported data on SA and injury, or that such data are not certified by a physician, which may introduce biased estimates [9,10]. In Sweden, SA-spells with durations of more than seven days have to be certified by a physician and are for most employed individuals registered in administrative registers of the Swedish Social Insurance Agency (SSIA) after day 14.

The aim of this study was to investigate occurrence of already ongoing SA and DP, and new SA spells exceeding 14 days, in general and for different injury diagnoses, among passenger car occupants receiving medical healthcare after being injured in a road traffic crash.

II. METHODS

Study Population

A population-based study was conducted, using microdata from the following four Swedish nationwide administrative registers:

- The patient register and the cause of death register, administrated by the National Board of Health and Welfare. To identify the car occupants who had received in- and specialised outpatient healthcare due to injuries from car crashes, regarding dates of care, and types of injuries and crash, dates of death and for exclusion criteria)
- The Longitudinal Integration Database for Health Insurance and Labour Market Studies (LISA), held by Statistics Sweden, regarding sociodemographics as of 31 December 2009.
- The MicroData for Analysis of the Social Insurance database (MiDAS) administrated by the SSIA , regarding dates and grades of SA and DP.

Data were linked on an individual level, based on the personal identification number assigned to all residents of Sweden. The study population was identified among the approximately 6 million individuals aged 16-64 years and registered as living in Sweden on 31 December 2009.

Included were all 13,948 car occupants who in 2010 were injured and had in- or specialised outpatient healthcare in Sweden, after a road traffic crash (according to the International Classification of Diseases 10th Revision (ICD-10-SE) external causes of morbidity codes V40-V49) [11]. Excluded from those were individuals who at any time during the three years prior to the date of the crash had been treated for a traffic-related crash injury (n=1 520) in order to only include incident injuries. Excluded were also those involved in accidents in non-traffic situations, i.e., people injured when boarding/alighting the car or injured outside of the car (n=1 887) and those who died ≤30 days after the crash (n=99). Furthermore, we excluded individuals that had neither injury diagnosis nor the ICD code Z04.1 (examination and observation following transport accident) (n=895), and those who had codes T90-T98 stating late effects (>1 year) of injuries and thus not representing a healthcare visit due to an incident car crash (n=120). The final study population thus consisted of 9,427

individuals. Within this group, the number of healthcare visits on the inception day varied from one to five. Each of these visits was coded with a main diagnosis, with the addition of secondary diagnoses, if any. A majority, 79%, of the people in the study population only had one unique diagnosis code. For the remaining 21%, a selection was made from existing codes to reach one injury diagnosis code for categorisation, per person. The following selection hierarchy was used: main diagnosis > secondary diagnoses, inpatient care diagnosis > outpatient care diagnosis, and injury diagnosis > other types of diagnoses.

Sickness Absence and Disability Pension Benefits in Sweden

All people living in Sweden, ≥16 years old with income from work, unemployment or parental leave benefits could be granted SA paid by the SSIA, if the disease or injury has led to reduction of work capacity [12]. These benefits amount to about 80% of lost income up to a certain level. The first day of a sick-leave spell was an unreimbursed qualifying day (more for self-employed). A physician's certificate is required after day 7. For most employees, day 2-14 was reimbursed by the employer as sick pay [12]. Disability pension can be granted if disease or injury leads to more permanent work incapacity with a maximum benefit of 64% of lost income, up to a certain level. Both SA and DP could be granted for full- or part-time (25, 50, 75%) of ordinary work hours.

In this study, SA and DP status at the time of the healthcare visit was assessed. A new SA spell was defined as a spell lasting for >14 days, irrespective of grade (full- or part-time). Healthcare visits may not occur on the same day as the crash and subsequent SA spell start date. Based on the distribution of start dates of SA spells, a *new SA spell* was defined as a spell starting ±4 days of the date of the healthcare visit leading to inclusion in the study group. Sickness absence that was ongoing already five days prior to, and DP that was ongoing at the date of, the healthcare visit were considered as already ongoing, that is, the patient was already on SA/DP when injured. Patients on part-time DP were still at risk for SA for the remaining percentage of working time.

Covariates

1) Sociodemographic factors were categorised as follows:

Age: 16-24, 25-34, 35-44, 45-54, and 55-64 years old; Level of education: elementary school (≤9 years), high school (10-12 years) and college/university (>12 years); Country of birth: Sweden, Europe other than Sweden, and Rest of the world. Type of living area: Big cities, Medium cities, and Small cities/villages. Civil status: Married/living with a registered partner (yes/no).

2) Healthcare, injury and crash related factors

Healthcare in relation to the crash: specialised outpatient care, inpatient care ≤1 day, and inpatient care ≥2 nights.

Type of injury was derived from the Barell matrix [13]. The matrix was modified by mapping ICD-10-SE to the original ICD-9-CM codes, and adding ICD-10 code Z04.1 (examination and observation following transport accident). Ten injury categories were created for the main analyses: Sprain of cervical spine, Concussion, Other traumatic brain injury (TBI), Injuries to the vertebral column and spinal cord, Injuries to the torso, Injuries to an upper extremity, Injuries to a lower extremity, Other and unspecified, and Observation and complications. The category Sprain of the cervical spine includes injuries diagnosed as whiplash associated disorders (WAD): Due to lack of detail in the ICD-coding in the register, WAD could not be discriminated from other sprains.

Type of crash was derived from the ICD10 codes and categorised into five groups: Collision with pedestrian, animal or pedal cycle, Collision with vehicle (motor vehicles, including railway trains, and non-motor vehicle), Collision with fixed or stationary object, and Non-collision traffic accidents, i.e., overturning cars, not involved in collisions or not otherwise specified.

Statistical Analysis

Descriptive statistics were used to describe the study population as well as crash- and injury type, for all and stratified by sex. Descriptive statistics were also used to investigate the utilisation of medical care, prevalent SA and DP at the time of the crash as well as incident SA, for all, and stratified by age

group and crash type. Crude and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for incident SA were calculated with logistic regression analyses. Univariate analysis was used to assess the association between factors potentially influencing the outcome; those found to have a statistically significant association were included in the adjusted models. The variable sex was included in the adjusted models. A multivariable model using injury type categories was created, mutually adjusting for all included covariates. For the purpose of investigating specific diagnosis groups, a second multivariable model was created, including only individuals with a selected diagnosis of fracture to the torso, the vertebral column or the upper or lower extremities. The regression analyses were stratified into age, with categories 16-44 years, and 45-64 years old. Data processing and analyses were performed using SPSS for Windows.

III. RESULTS

Of the 9427 injured car occupants, 48% were women (Table I), the majority were born in Sweden (80%) and unmarried (70%).

TABLE I
DESCRIPTIVE STATISTICS OF THE STUDY POPULATION, FOR ALL AND FOR WOMEN AND MEN, RESPECTIVELY

	Total		Women		Men	
	n	Percent	n	Percent	n	Percent
All* (row %)	9427		4487	47.6	4940	52.4
Age group, years						
16-24	3103	32.9	1423	31.7	1680	34.0
25-34	2173	23.1	1014	22.6	1159	23.5
35-44	1842	19.5	897	20.0	945	19.1
45-54	1352	14.3	669	14.9	683	13.8
55-64	957	10.2	484	10.8	473	9.6
Level of education (years)						
Elementary school (≤9)	2638	28.0	1071	23.9	1567	31.7
High school (10-12)	4569	48.5	2090	46.6	2479	50.2
College/University (>12)	2220	23.5	1326	29.6	894	18.1
Country of birth						
Sweden	7576	80.4	3703	82.5	3873	78.4
Europe other than Sweden	343	3.6	182	4.1	161	3.3
Rest of the world	1508	16.0	602	13.4	906	18.3
Married						
Yes	2801	29.7	1413	31.5	1388	28.1
No	6626	70.3	3074	68.5	3552	71.9
Type of living area						
Big cities	2997	31.8	1418	31.6	1579	32.0
Medium-sized cities	3678	39.0	1773	39.5	1905	38.6
Small cities/villages	2752	29.2	1296	28.9	1456	29.5

Column percentages if not else stated. *Aged 16-64 years and living in Sweden on 31 December 2009, receiving medical care for road traffic injury sustained as a passenger car occupant in 2010, with no medical care or SA/DP benefits due to traffic injuries in the three years prior to the date of the accident.

The most common crash type, based on ICD-classification, was collision with other vehicles, which

constituted half of the crashes in the study population (Table II). Sixteen percent of crashes were of non-collision type, which includes e.g., overturning cars not involved in collisions. A fifth of the study population was coded as having had an unspecified traffic accident. Sprains of the cervical spine, including WAD, was the most common injury type (26.6%) followed by injuries classified as other head, face and neck (23.8%) and Torso (15.1%).

TABLE II
DESCRIPTIVE STATISTICS OF CRASH TYPE AND INJURY TYPE (N=9427)

	Total		Women		Men	
	n	Percent	N	Percent	n	Percent
Crash type						
Unspecified traffic accident	2146	22.8	976	21.8	1170	23.7
Collision with pedestrian, animal or pedal cycle	406	4.3	180	4.0	226	4.6
Collision with motor- or non-motor vehicle	4684	49.7	2410	53.7	2274	46.0
Collision with fixed or stationary object	673	7.1	280	6.2	393	8.0
Non-collision traffic accident	1518	16.1	641	14.3	877	17.8
Injury type						
Other TBI	98	1.0	36	0.8	62	1.3
Concussion	374	4.0	145	3.2	229	4.6
Other head, face and neck	2246	23.8	1086	24.2	1160	23.5
Vertebral column and spinal cord	453	4.8	196	4.4	257	5.2
Sprain of the cervical spine	2507	26.6	1338	29.8	1169	23.7
Torso	1426	15.1	680	15.2	746	15.1
Upper extremity	987	10.5	384	8.6	603	12.2
Lower extremity	579	6.1	258	5.7	321	6.5
Other and unspecified	133	1.4	60	1.3	73	1.5
Observation and complications	624	6.6	304	6.8	320	6.5

Traumatic Brain Injury: TBI

A tenth of the study population had an ongoing SA or full-time DP at the time of the crash, while another 10th started a new SA >14 days (Table III). The median duration of new SA spells was 44 net days, and the mean was 126 days (SD 216). Proportions of SA and DP followed an age-related trend, with a larger proportion of individuals in the older age groups already being on SA or DP, but also starting a new SA. The proportion of individuals with new SA was, however, similar in the different crash type groups. A vast majority of individuals had specialised outpatient care only (82%), while half (47%) of those hospitalised for ≥2 days had new SA.

TABLE III
SICKNESS ABSENCE STATUS, FOR ALL AND STRATIFIED BY AGE, SEX, CRASH TYPE AND INITIAL MEDICAL CARE (N=9427)

	Total		Sickness absence and disability pension					
			No SA/DP		Already on SA or full time DP		New SA*	
	n	colum n %	N	row %	n	row %	n	row %
All	9427	100	7695	81.6	834	8.8	898	9.5
Age group								
16-24	3103	32.9	2864	92.3	86	2.8	153	4.9
25-34	2173	23.1	1827	84.1	141	6.5	205	9.4
35-44	1842	19.5	1427	77.5	182	9.9	233	12.6
45-54	1352	14.3	961	71.1	216	16	175	12.9
55-64	957	10.2	616	64.4	209	21.8	132	13.8
Sex								
Women	4487	47.6	3595	80.1	472	10.5	420	9.4
Men	4940	52.4	4100	83.0	362	7.3	478	9.7
Crash type								
Unspecified traffic accident	2146	22.8	1734	80.8	217	10.1	195	9.1
Collision with pedestrian, animal or pedal cycle	406	4.3	324	79.8	37	9.1	45	11.1
Collision with motor- or non-motor vehicle	4684	49.7	3831	81.8	413	8.8	440	9.4
Collision with fixed or stationary object	673	7.1	551	81.9	54	8.0	68	10.1
Non-collision traffic accident	1518	16.1	1255	82.7	113	7.4	150	9.9
Medical care								
Specialised outpatient care only	7718	81.9	6653	86.2	619	8.0	446	5.8
Inpatient care ≤1 day	1185	12.6	858	72.4	120	10.1	207	17.5
Inpatient care ≥2 days	524	5.6	184	35.1	95	18.1	245	46.8

Sickness absence: SA, Disability pension: DP, *≤4 days prior and ≤4 days post-crash date

In the univariate analyses Sex did not have a statistically significant effect on the outcome. In accordance to this result, multivariable analysis showed no sex difference regarding SA in relation to a car crash (Table IV). While those with high school education were more likely to have a new SA compared to those with college/university (OR: 1.41; 95% CI: 1.18-1.70), those with elementary school were less likely (OR: 0.76; 0.60-0.95). Those born outside of Europe had higher ORs for new SAs compared to those born in Sweden (OR: 1.29; 1.04-1.65). When stratifying the analysis by age, this association was statistically significant only for the age group 16-44 years (OR: 1.31; 1.04-1.65). Those married were more likely to have a new SA than those unmarried. When stratifying by age this association was statistically significant for those aged 16-44 years (OR: 1.71; 1.39-2.10). The injury type that was most likely to result in a new SA was Injuries to the vertebral column and spinal cord (OR: 8.64; 6.45-11.57). The ORs of a new SA increased with higher age for all injury type categories compared to the reference category.

TABLE IV
CRUDE AND MUTUALLY ADJUSTED ODDS RATIOS (OR) WITH 95% CONFIDENCE INTERVALS (CI) FOR NEW SICKNESS ABSENCE (SA) >14 DAYS, FOR ALL, AND STRATIFIED BY AGE

	All (n=8593)				**Age 16-44 (n=6709)**				**Age 45-64 (n=1884)**			
	Crude		**Adjusted**		**Crude**		**Adjusted**		**Crude**		**Adjusted**	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**	**OR**	**CI**	**OR**	**CI**	**OR**	**CI**
Sex												
Men	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Women	1,00	0.87-1.15	1.10	0.95-1.27	1.03	0.87-1.22	1.13	0.94-1.35	0.91	0.7-1.16	1.02	0.79-1.33
Level of education (years)												
College/University (>12)	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
High school (10-12)	1.40	1.18-1.67	1.41	1.18-1.70	1.40	1.12-1.74	1.45	1.15-1.83	1.61	1.20-2.15	1.39	1.02-1.89
Elementary (≤9)	0.79	0.63-0.97	0.76	0.60-0.95	0.69	0.53-0.89	0.66	0.50-0.87	1.68	1.16-2.44	1.54	1.04-2.28
Country of birth												
Sweden	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Europe other than Sweden	1.28	0.90-1.82	1.05	0.72-1.52	1.19	0.71-2.02	1.11	0.64-1.91	0.97	0.60-1.57	0.75	0.45-1.26
Rest of the world	1.43	1.20-1.71	1.29	1.07-1.56	1.54	1.25-1.90	1.31	1.04-1.65	1.24	0.89-1.72	1.22	0.86-1.74
Married												
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.65	1.43-1.90	1.63	1.39-1.90	1.74	1.45-2.09	1.71	1.39-2.10	0.92	0.72-1.17	0.95	0.73-1.23
Injury												
Sprain of the cervical spine	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Other TBI	6.09	3.56-10.43	6.99	4.04-12.08	3.90	1.91-7.94	5.07	2.45-10.48	13.88	5.52-34.87	14.68	5.80-37.17
Concussion	2.42	1.65-3.57	2.66	1.80-3.93	2.01	1.27-3.20	2.34	1.46-3.74	3.98	1.92-8.23	3.97	1.91-8.25
Other head, face and neck	1.14	0.87-1.48	1.18	0.90-1.54	0.88	0.64-1.21	0.93	0.67-1.28	2.19	1.31-3.68	2.14	1.27-3.59
Spine (Vertebral column and spinal cord)	8.06	6.05-10.75	8.64	6.45-11.57	5.51	3.88-7.83	6.32	4.42-9.05	18.04	10.30-31.59	17.32	9.85-30.48
Torso	2.95	2.30-3.78	3.03	2.36-3.89	2.38	1.77-3.20	2.53	1.88-3.41	4.65	2.84-7.61	4.50	2.75-7.37
Upper extremity	4.37	3.39-5.62	4.51	3.49-5.82	4.00	2.99-5.36	4.26	3.17-5.74	5.37	3.22-8.97	5.28	3.15-8.84
Lower extremity	5.48	4.14-7.24	5.82	4.39-7.73	5.10	3.70-7.02	5.64	4.08-7.81	6.79	3.81-12.11	6.73	3.75-12.05
Other and unspecified	2.23	1.22-4.08	2.06	1.12-3.79	2.14	1.08-4.26	1.98	0.99-3.96	2.58	0.72-9.25	2.49	0.69-8.97
Observation and complications	0.91	0.59-1.41	0.93	0.60-1.45	0.77	0.46-1.31	0.81	0.48-1.38	1.39	0.63-3.07	1.38	0.62-3.04

Traumatic Brain Injury: TBI

The results of the second multivariable model, including fracture diagnoses categorised by body region is shown in Table V. Among those 16-44 years old, fracture of the lower extremities was the fracture category most likely to result in new SA (OR: 3.30; 1.82-5.99). Among those 45-64, fractures of the vertebral column was the category associated with the highest OR (4.59; 2.21-9.55).

TABLE V
CRUDE AND ADJUSTED ODDS RATIOS (OR) WITH 95% CONFIDENCE INTERVALS (CI) FOR NEW SICKNESS ABSENCE (SA) AMONG INDIVIDUALS WITH FRACTURE TO THE TORSO, VERTEBRAL COLUMN OR EXTREMITIES, FOR ALL, AND STRATIFIED BY AGE

	Crude		Adjusted*	
	OR	CI	OR	CI
All (n=748)				
Fracture torso	Ref		Ref	
Fracture vertebral column	2.26	1.49-3.43	2.58	1.67-3.96
Fracture upper extremity	2.12	1.40-3.21	2.34	1.53-3.59
Fracture lower extremity	2.55	1.62-4.03	2.89	1.81-4.63
Age 16-44 (n=501)				
Fracture torso	Ref		Ref	
Fracture vertebral column	1.73	1.01-2.95	2.21	1.26-3.86
Fracture upper extremity	2.12	1.25-3.58	2.62	1.51-4.54
Fracture lower extremity	2.67	1.51-4.72	3.30	1.82-5.99
Age 45-64 (n=247)				
Fracture torso	Ref		Ref	
Fracture vertebral column	4.28	2.10-8.73	4.59	2.21-9.55
Fracture upper extremity	2.34	1.17-4.69	2.42	1.19-4.91
Fracture lower extremity	2.55	1.16-5.58	2.88	1.28-6.45

*Sex, level of education, country of birth and civil status were adjusted for.

IV. DISCUSSION

This nationwide study investigated SA and DP among car occupants of working-age (16-64) whom had in- or specialised outpatient care after a car crash, in the year 2010. Out of the study population 9% were already on SA or full-time DP prior to the healthcare visit related to the crash, while almost 10% had a new SA >14 days in relation to the crash/healthcare visit.

Previous studies, which also used data from Swedish populations, have reported higher proportions of SA among those injured in traffic crashes, 40% among car occupants in years 1990 and 1991 [8], and 66% among people injured in road traffic accidents in 1970 [7]. However, these studies also include SA-spells of shorter duration. It has previously been reported that most SA-spells have ended within one week [14], a lower proportion of SA spells >14 days would thus be reasonable. Nevertheless, the study from 1970 found 25% to have a SA-spell longer than three weeks. Over time, improvements of road infrastructure, as well as car safety have contributed to a reduction of severe injuries. For example, divided roads have been found to reduce crash severity [15], the crashworthiness of the vehicle fleet has also improved over time [16] and thereby car safety concepts have been found to reduce the risk of long-term consequences of WAD [17]. In the social insurance, qualifying days for sickness benefits and lowered compensation grades have been

introduced [18].

In the present study, the proportions of new SA increased with age. This is in line with previous research. That a higher age correlate with a higher risk of injuries from motor vehicle crashes has been found in several studies [19,20], and a higher risk of injuries resulting in permanent medical impairment (PMI) among older car occupants has also been shown [20]. In the multivariable logistic regression analysis it was found that among those aged 16-44, individuals born outside Europe, or married were more likely to have a new SA compared to individuals born in Sweden and those unmarried, respectively. Like in the present study, higher proportion of SA has in some instances previously been found among those married, while in other instances among those unmarried [18]. In the present study, the OR for new SA was higher among those with lower levels of education, except for those 16-44 years old with elementary school as their highest education. This exception from the trend may be due to a lower proportion in this group having passed from education to paid work. If education level can be seen to act as a proxy for type of work, these results may be compared to another study showing the result that among patients with WAD, manual workers took more days off work than those with a more sedentary occupation [21].

Sprains of the cervical spine, including WADs, is one of the most frequently reported diagnoses after a car crash. In the present study this injury type constituted more than a quarter of all diagnoses. When it comes to productivity loss in the form of SA and DP, the present study found that a low proportion (5%) of individuals with sprains of the cervical spine had a new SA>14 days. It was in fact the injury type least likely to result in a new SA. Other studies have found contrasting results regarding these types of injuries, often defined as WAD. They have been found to account for a large proportion of the total sick-leave days among patients after a crash [8], but that the median duration of days off from work is short [21]. In some cases these injuries have long-term consequences, almost a fifth of all WADs have been shown to result in PMI [22], and some studies report SA and DP many years after the crash [10,23]. A study reported that 59% reported working fewer hours after the crash, due to the neck complaints [9]. About a month after the crash, this proportion was 34%, and after one year 13%. One of the reasons for a lower proportion of new SA for sprains of the cervical spine in the present study is the definition of SA representing spell durations of >14 days. Also, some of the studies used significantly older data material which might affect results, since the assessment of this type of injuries has changed over time, and efforts made by car manufacturers to reduce risks of WAD have been successful [17]. In general, it has been found that the newer the car, the lower proportion of drivers with symptoms lasting longer than one month, as well as PMI.

The proportion of individuals receiving inpatient care ≥2 days varied between crash types, which could implicate differences in injury severity. The highest proportion was found in the subgroup Collisions with fixed or stationary object. A previous study showed that the average mean acceleration was 45% higher in single-vehicle crashes with rigid roadside objects than in collisions with deformable objects [24] and thereby inferring a higher injury risk [25]. The proportion with new SA did, however, not differ much between different crash types.

Injuries to the vertebral column and spinal cord, and traumatic brain injuries except concussion were the injury categories with the highest ORs for SA, using sprains to the cervical spine as the reference category. This is in line with the notion that about one third of severe brain injuries have been found to result in persistent symptoms affecting activities of daily life, based on PMI classification [22]. The same result was found for approximately a third of spine injuries, which do not include sprains, a fifth of thoracic spine injuries, and a few percent of injuries to the lumbar spine, of the same severity. While mild traumatic brain injury (TBI), i.e., concussions, represents the majority of TBIs and in most cases resolve within a matter of days or weeks [26], more severe forms of TBI can result in substantial cognitive and physical disability, increasing with injury severity [27]. In general they also result in long-term SA [28]. The present study found SA >14 days to be a very common consequence of such more severe TBIs after crashes.

Being sickness absent is one way to describe consequences of traffic injuries, however individuals' health might be affected in other ways while not resulting in SA.

There are other ways to describe long-term consequences of traffic injuries, e.g., PMI and health-related quality of life. Further research into how these measurements differ and correlate is warranted to give a more complete picture of long-term consequences after road traffic crashes.

A. Strenghts and limitations

The strengths of this study include that it was population-based, including all individuals who fulfilled the inclusion criteria, the large study population allowing sub-group analysis, the use of data from several nationwide registers of high coverage and quality, linked on an individual level. Another advantage of the data is that all those already on SA or full-time DP at the time of the healthcare visit, i.e., not being at risk of new SA, could be identified. This is an important strength of this study – other studies can seldom differentiate between SA resulting from the injury if the injured was already on SA at the time of the crash. The data also made it possible to control a number of factors in the regression analyses.

All individuals in Sweden are covered by the same healthcare insurance and the study group was identified from inpatient and specialised outpatient healthcare registers. Inclusion in the study is, thus, based on a diagnosis from a physician. However, a limitation of the study is that we could not include people who only had primary healthcare. Another limitation is that information on crash dates was not available, but rather dates for inpatient and specialised outpatient care. To allow for some time between the crash, healthcare visit and first day of sick leave, in any order, incident SA was, based on a frequency analysis, defined as spells starting within ±4 days in relation to the healthcare visit.

Information on crash types in the study was derived from the external causes of morbidity codes of ICD10-SE. A limitation is the relatively large proportion of individuals who had been coded *Unspecified traffic accident* (23%). The lack of specific information for these individuals might have resulted in underestimation of the frequency and effects on medical care and SA of certain crash types.

The fact that one diagnosis per individual was selected for those individuals (21%) who had more than one due to secondary diagnoses or several healthcare visits the same day can also be seen as a limitation. First, the effects of multi-trauma have not been assessed in this study. Also, if an injury type category is more common in multi-trauma, the effects of this category on SA might have been overestimated. Secondly, the selection process might not have succeeded in pinpointing the injury relevant for the SA.

The definition of the incident SA as spells >14 days is a strength in the respect that all SA has been certified with a diagnosis by a physician and that all such SAs were registered by the SSIA and thus not based on self-report. Also, it covers the more severe cases. Other types of data are needed to gain knowledge on SA with shorter duration.

V. CONCLUSIONS

Results from this first nationwide study of injured car occupants among people of working ages showed that 9% were already on SA/DP while 10% had a new SA spell >14 days after a crash. Older age and being born outside Europe were associated with higher ORs of SA. Injuries to the spine and spinal cord were the injury types with the highest ORs for SA. The second highest OR was associated with the injury type TBI except concussion.

With an incidence of 10%, SA>14 days is a common consequence after being injured in a car crash. As an injury outcome, SA offers a perspective that may not be considered when studying initial injuries. Using SA as an injury outcome can widen the picture of the problem associated with road traffic trauma. In this respect, it could be used to guide road- and car safety strategies and measures.

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VII. REFERENCES

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