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## Diagnostic groups of risk in trauma patients as independent homogenous groups of patients. Proposal for a catalogue for National Health Foundation. Clinical estimation of costs of treatment: I. Epidemiology of body injuries

Diagnostyczne grupy ryzyka (DGR) w obrażeniach ciała, jako osobne jednorodne grupy pacjentów (jgp). Propozycja do katalogu NFZ. Ocena kliniczna kosztów leczenia:

### I. Epidemiologia obrażeń ciała

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#### Słowa kluczowe:

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Due to dynamic development of industry, urbanization, mechanization and finally present-day living condition and lifestyle, man, regardless of age and health condition, is a subject to injuries resulting not only in a just period of therapy but in many distant consequences as well. Those problems accomplish not only individual but also social dimension. Mechanism of trauma and localization of injuries resulting from it constitutes immanent feature characterizing trauma victim. It turns out however that there are other factors influencing injury itself, course of treatment and final outcome. Men more commonly sustain injuries than women (with the ratio about 2:1) and their injuries are more severe due to different mechanism of trauma. There is also a different course of the curves of incidence of trauma depending on age observed. Incidence is higher in younger men and older women than suspected on the basis of the structure of population and contrary - lower in older men and younger women. Retrospective study was performed to assess to what extent particular parameters - localization and extent of injury, age and gender of patients and severity of injury - are related to each other, how they influence the course of treatment and outcome. The other aim was assessment whether those parameters allow for differentiation of patients with injuries and whether they can serve as an indicator for epidemiological, substantial and logistic purposes of health care system and for planning their costs with regard to consequences of injuries. The group of 3614 patients with injuries constituted the study material for statistical analysis. The study group included 3435 patients hospitalized and 179 trauma victims who died during pre-hospital period during from 1.01.1999 to 31.12.2002. Data were obtained from medical documentation and from medical histories taken from the patients. On the basis of the statistical analysis the incidence of trauma in Krakow region for the period of 1999-2002 amounted to 596,72/100.000/year. Overall mortality rate reached on the average 46,25/100.000/year. Injuries of lower extremities constituted the most common localization (1241 patients -

Dynamiczny rozwój przemysłu, urbanizacji, mechanizacji, wreszcie warunki współczesnego życia i jego styl sprawiają, że człowiek, w każdym wieku i niezależnie od stanu zdrowia, narażony jest na uraz, którego następstwa nie ograniczają się tylko do okresu samego leczenia, ale również powodują wiele skutków odległych. Problemy te przestają dotyczyć tylko jednostki, ale przyjmują wymiar społeczny. Mechanizm urazu i lokalizacja obrażeń są immanentną cechą charakteryzującą każdą ofiarę wypadku. Okazuje się jednak, że zarówno na samo powstanie urazu, jego skutki, przebieg leczenia i ostateczny wynik wpływają inne jeszcze czynniki. Mężczyźni doznają obrażeń relatywnie częściej niż kobiety (w stosunku ok. 2:1), ich obrażenia są cięższe ze względu na inny mechanizm urazu. Wyraźnie odmienny jest też u mężczyzn i u kobiet przebieg krzywych urazowości w zależności od wieku. Zapadalność na uraz jest wyższa, niż należałoby tego oczekiwać na podstawie składu populacji, u młodszych mężczyzn i starszych kobiet i odwrotnie - niższa u starszych mężczyzn i młodszych kobiet. Badanie retrospektywne przeprowadzono, by sprawdzić, na ile poszczególne parametry - uszkodzona okolica ciała i rozległość obrażeń, płeć i wiek pacjentów oraz ciężkość urazu są między sobą zależne, jak wpływają na przebieg i wyniki leczenia, czy w dostateczny sposób różnicują one chorych z obrażeniami ciała i czy mogą pełnić rolę wskaźników dla potrzeb epidemiologicznych, merytorycznych i logistycznych systemu ochrony zdrowia i planowania jego kosztów odnośnie następstw urazów. Dokonano analizy statystycznej danych o 3614 chorych z obrażeniami ciała, w tym 3435 hospitalizowanych i 179 zmarłych w okresie przedszpitalnym. Dane o chorych zbierano w stworzonej dla potrzeb Katedry bazie PACJENCI. Według przeprowadzonych badań zachorowalność z powodu urazów w regionie krakowskim wynosiła w latach 1999-2002 średnio 596,72/100 tys./rok. Całkowita śmiertelność w badanej grupie wynosiła średnio 46,25/100 tys./rok. Najczęstsze okazały się obrażenia kończyny dolnej (1241 - 34,34%) i głowy (1095 - 30,30%), najrzadziej miedni-

34,34%), followed by injuries of head (1095 - 30,30%). Injuries of pelvis (73 patients - 2,02%) and abdomen (58 - 1,60%) were the least commonly found. Patients with injuries of lower extremities constituted the oldest group (55,96±22,42 years), followed by patients with injuries of the spine and pelvis. Patients with injuries of the abdomen were significantly younger (30,28±19,18 years). Male patients dominated in the group of patients with injuries of the abdomen (81,03%) and in the groups with most of the other injuries while female patients outnumbered slightly only in the group of patients with injuries of pelvis and lower extremities. In the group of patients with head injuries there were 25% of people under the influence of alcohol while in the other groups percentage of intoxicated patients amounted to less than 15%. Falls from standing and motor vehicle accidents constituted the most common mechanisms of injuries. Epidemiological data regarding consequences of injuries: incidence, mortality and percentage of patients, who require disability pension calculated for the population representative of Krakow are comparable to the ones found in Polish and worldwide literature. Slight differences in the number of years of potential life and work lost between the study material and data from the literature most probably results from the fact that nowadays more and more trauma victims survive injuries (especially severe ones), thus resulting in increase in the number of people with permanent impairment of the function of organism. Accordingly this results in higher incidence of posttraumatic disability. Influence of localization and severity of injuries, in common with age and gender of the patients, on the course of treatment and final outcome in the study material proved to be undoubted.

## Introduction

Due to dynamic development of industry, urbanization, mechanization and finally present-day living condition and lifestyle, man, regardless of age and health condition, is a subject to injuries resulting not only in a just period of therapy but in many distant consequences as well. Those problems accomplish not only individual but also social dimension. There were many studies performed (although for the last decade substantially fewer than in 80-ties and 90-ties of the 20<sup>th</sup> century) that tried to assess economical significance of trauma. Those studies were multidirectional, included many branches of science (not only medical) and used wide range of research techniques. The largest emphasis was placed on the mechanisms of injuries, their severity and consequences, methods of treatment and economical problems related to them with special attention to the amount of money spent by health care system on the treatment of trauma victims (with calculation of so called indirect costs of injuries).

In Poland more people die due to sustained injuries as compared with other countries (in the USA and European Union mortality rate equals 50/100.000, in Poland reaches 75). According to the study by Czyżewski, Wencel and Lipiński in Poland from 3.5 to 4.0 million of people sustain different injuries, 350.000 are hospitalized and about 32.000 die due to them [1]. By contrast in the USA about

60 million of people become injured, but only 150.000 dies as a result of trauma. There is an increase in the number of people who temporarily or permanently lose their jobs due to sustained injuries. Injuries are responsible for the largest number of years of potential life lost, incapacity to work, impairment and stated disability [2-5]. Mechanism of trauma and localization of injuries resulting from it constitutes immanent feature characterizing trauma victim. It turns out however that there are other factors influencing injury itself, course of treatment and final outcome. It has been commonly known for years that men more commonly sustain injuries than women (with the ratio about 2:1) and their injuries are more severe due to different mechanism of trauma. There is also a different course of the curves of incidence of trauma depending on age observed. Incidence is higher in younger men and older women than suspected on the basis of the structure of population and contrary - lower in older men and younger women. Younger patients, especially men, sustain injuries in the "active" mechanisms - so during active action (car and motorcycle accidents, fights, crushes, injuries during work with machinery), while older patients, especially women - in "passive" mechanisms (falls from standing, falls from heights, pedestrians hit by cars). This observation however does not explain correlation between the increase in the severity of injuries and

older age [5,7-11].

The fact of higher risk of injuries in older people - especially higher incidence of some fractures characteristically related to age and gender - is widely presented in the literature. In the USA incidence of trauma is three times higher in the group of people over 65 than in younger groups. In this group mortality rate is also significantly higher than in younger trauma victims [6-8,12-16].

To make such analysis possible there is a special tool necessary, allowing for assessment of severity of injuries as a result of the destructive forces applied. Anatomical trauma scales constitute such instrument. They are based on the determination of degree and extent of the damage of particular organs or systems. They allow for comparing the results of treatment of victims of different types of traumas, patients treated in different hospitals, in different time and with different injuries. Most of those scales are also strongly correlated with mortality and disability rates. There is a scale called Liczbowa Skala Obrażeń (LSO) invented in Poland that serves for this purpose [10,18,18].

Successive version of AIS - ICISS (International Classification of Disease, Ninth Revision-based Injury Severity Score) [19] compiled in 1995 constituted the first attempt to make related Injury Severity Score with the International Statistical Classification of Diseases and Related Health Problems (ICD 10) [20].

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**Table I**  
**General characterization of the study population.**

overall number of trauma victims	3819		596,72/100.000 / year for Krakow
included in the study	3614	94.63%	
women	1464	40.51%	53.41% of the population
men	2150	59.49%	46.59% of the population
mean age	49.09 ± 22.07	14-100 years	
the most common mechanisms of injuries	fall 1708 inside the vehicle 414 aggression 337	pedestrians 298 falls from heights 194 sport 174 stairs 127	disease 94 machinery 82 crush 49
alcohol	530	14.67%	
isolated injuries	3274	90.59%	2.73 ± 1.39 pkt LSO
including	head 1095 chest 163 abdomen 58	pelvis 73 spine 121 upper extremity 523	lower extremity 1241
multiple injuries	340	9.41%	12.01 ± 6.20 points of LSO
including	head 242 chest 187 abdomen 123	pelvis 68 spine 65 upper extremity 119	lower extremity 174
mean severity of injuries (LSO)	3.61 ± 3.56	1-20	
operated on*	2097	58.02%	
treated conservatively*	1338	37.02*	
hospitalization time* (days)	24955	7.26 ± 8.16	
ICU stay*	129	3.76%	
overall ICU stay * (days)	1269	8.84 ± 14.80	
geaths	296	8.19%	46,25/100.000 /year
pre-hospital deaths	179	60.47%	
in-hospital deaths	117	39.53%	
permanent disability**	318	12.69%	49,69/100.000 /year
number of years of potential life lost	9018		1409,06/100.000 /year
number of years of potential work lost	4664		728,75/100.000 /year
real direct costs	6 643 929	2.70% pośr.	
direct corrected costs ***	16 782 684	6.83% pośr.	
indirect costs	245 702 132	384/mieszk/rok	38 390 958/100 tys/rok

\* without deaths at the site of accidents

\*\* still on the disability pension and alive in 2007 (n=2506 osób)

\*\*\* costs calculated and corrected with the use of inflation index (1.7), costs of work (50% of all) and ICU costs according to TISS

Similar study in Poland was performed by Nogalski [21].

### Aim of the study

Retrospective study was performed to assess to what extent particular parameters - localization and extent of injury, age and gender of patients and severity of injury - are related to each other, how they influence the course of treatment and

outcome. The other aim was assessment whether those parameters allow for differentiation of patients with injuries and whether they can serve as an indicator for epidemiological, substantial and logistic purposes of health care system and for planning their costs with regard to consequences of injuries.

## Material and methods

The group of 3614 patients with injuries constituted the study material for statistical analysis. The study group included 3435 patients hospitalized during the "emergency duty days" in 2nd Chair of Surgery, Jagiellonian University Medical College, Krakow, Poland and 179 trauma victims who died during pre-hospital period during the same days (6 days a month for four years) on the territory inhabited by about 800.000 people over 14 from 1.01.1999 to 31.12.2002. The data were collected on the basis of computer database called "PACJENCI" (PATIENTS) compiled in our Chair.

Long-term follow-up was performed on the basis of special questionnaire from 2 to 8 years after the injury. Whole period of treatment of the patients (duration of temporary incapacity to work, disability and rehabilitation pensions) and number of patients who had to retire from the jobs were calculated. Data were obtained from medical documentation and from medical histories taken from the patients. Social insurance company (ZUS) refused to provide the access to their database on the basis of the Personal Data Protection Act and thus the data were collected for only (as many as?) 94.63% of the patients that were initially included in the study. Remaining 5.37% (205 patients) were excluded from the study due to lack of the data from ZUS, owing to incomplete data from medical histories or because they did not report to follow-up and did not fulfill the questionnaire.

Statistical analysis included calculation of sums, subtractions, mean values, percentages, standard deviations, T-Student tests and Chi2. Morbidity and mortality rates were also calculated on the basis of constant population (800.000 of inhabitants) and constant number of "emergency duty days" (6 days a month).

## Results

During the study period there were 3614 trauma victims. From this group 3425 patients were hospitalized and remaining 179 (4,95%) died at the site of accident or during transportation.

On the basis of the statistical analysis the incidence of trauma in Krakow region for the period of 1999-2002 amounted to 596,72/100.000/year. Overall mortality rate reached on the average 46,25/100.000/year.

Basic data of the study group includ-

**Table II**  
**Characterization of people with isolated injuries.**

	Head n = 1095 (30.31%) 171.1/100.000	Chest n = 163 (4.51%) 25.5/100.000	Abdomen n = 58 (1.60%) 9.1/100.000	Pelvis n = 73 (2.02%) 11.4/100.000	Spine n = 121 (3.35%) 18.9/100.000	Upper extremity n = 523 (14.47%) 81.7/100.000	Lower extremity n = 1241 (34.34%) 193.9/100.000
Age	42.24 ± 20.28	51.54 ± 20.13	30.28 ± 19.18	54.15 ± 24.67	53.79 ± 20.72	47.80 ± 20.92	55.97 ± 22.42
Women	377 (34.43%)	43 (26.38%)	11 (18.97%)	38 (52.25%)	46 (38.02%)	204 (39.01%)	634 (51.09%)
Men	718 (65.57%)	120 (73.62%)	47 (81.03%)	35 (47.95%)	75 (61.98%)	319 (60.99%)	607 (48.91%)
Alcohol	261 (23.84%)	24 (14.72%)	4 (6.90%)	4 (5.48%)	8 (6.61%)	70 (13.38%)	74 (5.96%)
Dominating mechanisms of injuries	Fall: 368 Aggression: 213 Inside the vehicle: 195	Fall: 52 Aggression: 37 Inside the vehicle: 27	Aggression: 26 Inside the vehicle: 13 Fall: 8	Fall: 34 Inside the vehicle: 10	Fall: 41 Fall from height: 32 Inside the vehicle: 24	Fall: 261 Other non-traffic: 80 Machinery: 61	Fall: 892 Sport: 119 Pedestrian: 54
LSO	2.32 ± 1.67	2.99 ± 1.58	2.90 ± 1.73	2.51 ± 0,96	3,14 ± 1,46	2,41 ± 0,65	3,17 ± 1,16
Hospitalization time*	3.81 ± 3.64	6.82 ± 6.54	5.25 ± 3.40	7.26 ± 8.92	5.53 ± 7.86	4.98 ± 5.18	10.39 ± 8.24
ICU stay*	247 days mean 6,68	110 days mean 10.00	5 days mean 2.50	7 days mean 3.50	101 days mean 20,20	2 days mean 2.00	72 days mean 4.24
Number of patients in the ICU*	37 (3.49%)	11 (7.14%)	2 (3.51%)	2 (2.74%)	5 (4.27%)	1 (0.19%)	17 (1.37%)
Operated on*	380 (34.70%)	55 (33.74%)	29 (50%)	11 (15.07%)	3 (2.48%)	431 (82.41%)	1042 (83.96%)
Treated conservatively*	680 (62.10%)	99 (60.74%)	28 (48.28%)	62 (84.93%)	114 (94.21%)	90 (517.27%)	198 (15.95%)
Deaths	65 (5.94%)	13 (7.98%)	2 (3.45%)	2 (2.74%)	10 (8.26%)	2 (0.38%)	36 (2.90%)
In-hospital*	30	4	1	2 (	6	0	35
Pre-hospital	35	9	1	0	4	2 (	1
Deaths per 100.000/year	10.16	2,03	0.31	0.31	0.47	0,31	5.62
Years of potential life lost: per deaths and per 100.000	1804,65 27.76 281.98	456.46 35.11 71.32	45.45 22.72 7.12	19.27 9.63 3.01	363.41 36.34 56.78	78.43 39.21 12.25	310.02 8.61 48.44

\*without patients who died in pre-hospital period

**Table III**  
**Characterization of people with multiple injuries (MOC).**

Age	Women	Men	Alcohol	Dominating mechanisms of injuries	LSO	Hospitalization wime*	ICU stay*	Number of patients in the ICU*
46.57 ± 20.68	111 (32.65%)	229 (67.35%)	85 (25.00%)	Piesi: 103 Inside the vehicle: 97 Fall: 52	12.01 ± 6.20	13.34 ± 16.98	725 (mean 13.43 days)	54 (25.35%)
Operated on*	Treated conservatively*	Deaths	In-hospital deaths	Pre-hospital deaths	Deaths per 100.000/year	Years of potential life lost: per deaths and per 100.000		
146 (42.94%)	67 (19.71%)	166 (48.82%)	39	127	25.94	5888.6 35.5 920.09		

\* without patients who died in pre-hospital period

ing characteristics of the patients, mechanism and type of sustained injuries, course of treatment and outcome, direct and indirect costs of trauma are presented in the table I. Those data are described in details in further parts of the paper.

#### **A. Injuries of particular body regions**

Injuries of particular body regions of the group of 3274 patients with the isolated injuries are summarized in the table 2. Injuries of lower extremities constituted the most common localization (1241 patients - 34.34%), followed by injuries of head (1095 - 30.30%). Injuries of pelvis

(73 patients - 2.02%) and abdomen (58 - 1.60%) were the least commonly found. Patients with injuries of lower extremities constituted the oldest group (55.96 ± 22.42 years), followed by patients with injuries of the spine and pelvis. Patients with injuries of the abdomen were significantly younger (30.28 ± 19.18 years). Male patients dominated in the group of patients with injuries of the abdomen (81.03%) and in the groups with most of the other injuries while female patients outnumbered slightly only in the group of patients with injuries of pelvis and lower extremities. In the group of patients

with head injuries there were 25% of people under the influence of alcohol while in the other groups percentage of intoxicated patients amounted to less than 15%. Falls from standing and motor vehicle accidents constituted the most common mechanisms of injuries.

Injuries of lower extremities and spine proved to be the most severe (3.17±1.16 and 3.14 ± 1.46, respectively), while injuries of head and upper extremities - the least severe (2.32 ± 1.67 and 2.41 ± 0.65, respectively). However no correlation with the duration of hospitalization was found - patients with injuries of lower ex-

**Table IV**  
Causes and results of injuries in women and men.

	Women n = 1464		Men n = 2150
Age	59.15 ± 23.04	p <0.01	42.23 ± 18.49
Alcohol	46 (3.14%)	p <0.01	484 (22.51%)
Dominating cause	Fall: 959 Inside the vehicle: 153 Pedestrians: 92		Fall: 749 Aggression: 277 Inside the vehicle: 257
Multiple injuries	111 (7.58%)	p <0.01	229 (10.65%)
Isolated	1353 (92.42%)	p <0.01	1921 (89.35%)
head	377 (27.86%)		718 (37.38%)
chest	43 (3.18%)		120 (6.25%)
abdomen	11 (0.81%)		47 (2.45%)
pelvis	38 (2.81%)		35 (1.82%)
spine	46 (3.40%)		75 (3.90%)
upper extremity	204 (15.08%)		319 (16.61%)
lower extremity	634 (46.86%)		607 (31.60%)
Severity of injuries (LSO)	3.46 ± 2.96	p <0.01	3.71 ± 3.92
Operated on*	880 (60.11%)	=	1217 (56.60%)
Treated conservatively*	543 (37.09%)	=	795 (36.98%)
Hospitalization time*	8.43 ± 8.75	p <0.01	6.44 ± 7.61
ICU stay* - patients	35 (2.46%)	p <0.01	94 (4.67%)
ICU stay* - days	281 (mean. 8.03)	p <0.01	988 (mean. 10.51)
Deaths	85 (5.81%)	p <0.01	211 (9.81%)
in-hospital*	44	p <0.01	73
pre-hospital	41	p <0.01	138
per 100.000	13.28		32.97
Years of potential life loss	2040.31		6921.98
mean for 1 death	20.44		32.81
for 100.000	318.75		1081.56

\*without patients who died in pre-hospital period,

\*\*in 8 cases unknown

**Table V**  
Trauma victims in Ageu groups (%) in with reference to general population.

Age	Trauma victims (%)			Women	Men	overall
	Women	Men	overall			
before 19	5.67	8.51	7.36	7.01	8.28	7.60
20-39 years	18.51	39.40	30.96	36.01	40.39	38.06
40-59 years	20.29	32.10	27.28	31.88	32.62	32.23
over 60	55.53	20.00	34.39	25.10	18.71	22.11

tremities and pelvis were hospitalized for the longest time (10.39 ± 8.24 and 7.26 ± 8.92, respectively), while patients with head injuries - for the shortest time (3.81 ± 3.64). The latter group however outnumbered the other groups of patients requiring hospitalization in the ICU, while in terms of duration of stay in ICU patients with injuries of spine and chest dominated (20,2 and 10 days, respectively); table II.

Percentage of patients operated on was found to be the highest in the groups of patients with injuries of lower and upper extremities (over 80%), while the lowest in patients with injuries of the spine (less than 2.5%).

In the group of hospitalized patients mortality rate was the highest in patients with isolated injuries of the spine (more than 8%), while the lowest in patients with injuries of the upper extremities (0.38%).

In the group of patients who died in pre-hospital period patients with chest injuries dominated (more than 5.5%). More than half of years of potential life lost was related to head injuries (184.65).

340 patients sustained multiple injuries (9.41%). This group of patients was on the average 3 years younger, with (more significant as compared to the other) domination of male patients. Patients with multiple injuries twice more common were intoxicated. Dominating mechanisms of injuries were pedestrians hit by cars followed by injuries inside the vehicles. Patients with multiple injuries were more than 10 times more often hospitalized in the ICU, and stay in the ICU lasted twice longer. More than 67% patients with multiple injuries were operated on (as compared to 60% of patients with isolated injuries).

166 patients with multiple injuries died (48.82%), but vast majority of them in the pre-hospital period (127 - 76.51%). In-hospital mortality rate amounted in this group to 18.31%. In contrast in the group of patients with isolated injuries 130 (3.97%) died, but only 52 of them (1.59%) during pre-hospital period, and remaining 78 in hospital. In-hospital mortality rate reached 2.42% - table III.

### **B. Gender of patients**

There were 1464 women (40,51%) and 2150 men in the study group. Gender distribution differed significantly from general population of Krakow, in which women dominated (p<0.01) - figure 1.

Women were significantly older than men (59.15±23,04 and 42.23±18.49 years, respectively - p <0.01). They seven times less commonly sustained injuries under influence of alcohol. Differences in the mechanisms of injuries between male and female patients did not - in contrast to general opinion - prove to be significantly different, although it's worth to mention the role of acts of aggression in injuries of men. Male patients only slightly more commonly sustained multiple injuries (more than 10.5% vs. more than 7.5%).

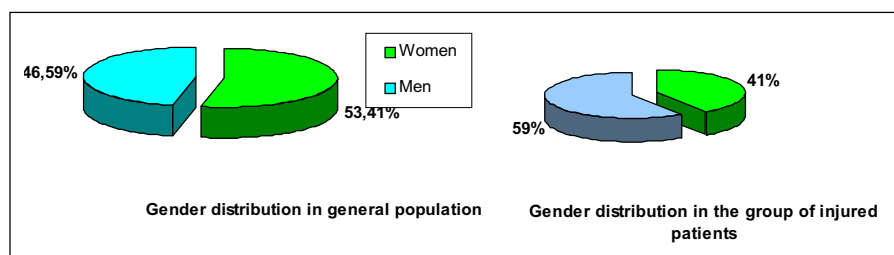
However there was different localization of injuries found in both genders. In women the most common injuries were as follows: injuries of lower extremities (almost half of cases) and head (more than 1), followed by injuries of upper extremities (15%). Other body regions were injured with frequency about 1-3%. In men injuries of head dominated (more than 37%).

**Table VI**  
Causes and consequences of injuries in Ageu groups.

	14 - 19 years n=266	20 - 39 years n=1119	40 - 59 years n=986	≥ 60 years n=1243
Men	183 (68.80%)	848 (75.78%)	689 (69.88%)	813 (65.41%)
Women	83 (21.20%)	271 (24.22%)	297 (30.12%)	430 (34.59%)
Alcohol	18 (6.77%)	228 (20.38%)	206 (20.89%)	78 (6.28%)
Dominating cause	Fall: 49 Inside the vehicle: 45 Sport: 42 Aggression: 41	Inside the vehicle: 204 Aggression: 181 Sport: 101	Pedestrian: 153 Aggression: 90 Up. Fall from height: 69	Fall: 900 Pedestrian: 91
MOC	16 (6.02%)	128 (11.44%)	87 (8.82%)	109 (8.77%)
Isolated	250 (93.98%)	991 (88.56%)	899 (91.18%)	1134 (91.23%)
head	109 (40.98%)	454 (40.57%)	287 (29.11%)	245
chest	7 (2.63%)	40 (3.57%)	57 (5.78%)	59
abdomen	17 (6.39%)	24 (2.14%)	8 (0.81%)	9
pelvis	6 (2.26%)	16 (1.43%)	18 (1.83%)	33
spine	7 (2.63%)	26 (2.32%)	30 (3.04%)	58
upper extremity	44 (16.54%)	159 (14.21%)	148 (15.01%)	172
lower extremity	60 (22.56%)	272 (24.31%)	351 (35.60%)	558
Severity of injuries (LSO)	2.77 ± 2.60	3.46 ± 3.89	3.60 ± 3.84	3.92 ± 3.15
Operated on*	130 (48.87%)	615 (54.96%)	565 (57.30%)	787 (63.31%)
treated conservatively*	127 (47.74%)	437 (39.05%)	363 (36.82%)	411 (33.07%)
Hospitalization time*	4.28 ± 3.96	4.99 ± 5.90	6.98 ± 8.38	10.12 ± 9.39
ICU stay* - patients	5 (1.95%)	35 (3.33%)	36 (3.88%)	53 (4.42%)
ICU stay* - days	9 (mean 1.80)	305 (mean 8.71)	470 (mean 13.06)	485 (mean 9.15)
Deaths	12 (4.51%)	91 (8.13%)	85 (8.62%)	108 (8.69%)
in-hospital	3	24	27	63
pre-hospital	9	67	58	45
for 100.000	1.87	14.22	13.28	16.87
Years of potential life loss	685.18	4472.52	2720.42	1084.17
mean for 1 death	57.10	49.23	32.00	10.04
for 100.000	107.06	698.7	425	169.37

\*without patients who died in pre-hospital period,

\*\*in 8 cases unknown



**Figure 1**  
Gender distribution in the general population and in the group of injured patients (respectively).

Male patients sustained more severe injuries, hence they twice more commonly required hospitalization in ICU and stayed there on the average 2.5 days longer. However, overall hospitalization time in the group of men was only 2 days longer. Mortality rate was almost twice higher in

male group (9.81% vs. 5.81%), yet in this group road traffic deaths dominated (2/3 of cases), while in female group such causes of death did not reach 50%. Men had 3.5 times higher number of years of potential life lost than women and 3 times more for 100.000 inhabitants (table IV).

### C. Age of patients

Table V presents age groups (overall, women and men) in population of Krakow magistrate district, Krakow land district and Wieliczka district, so area covered by emergency services of our Department. Overall this area was inhabited by 800 thousands of adults. In the group of women the incidence of injuries was lower than expected before 59 and more than twice higher in the group over 60. In the group of men distribution of injuries was similar to the age composition of population. Overall incidence of injuries was lower than expected for people aged from 20 to 59 and twice higher than expected for the oldest group. Percentage of women increased in the group of injured patients together with age, from 21.2% in the youngest group to 34.59 in the oldest group (table VI).

Alcohol intoxication was found in more than 30% of injured patients aged from 30 to 59, and less than 7% in the youngest and the oldest groups. Incidence of road traffic injuries decreased with age and incidence of multiple injuries was the least common in the youngest group. Head injuries dominated in the youngest groups, in people aged 40-59 there was increase in the number of extremities injuries observed, while injuries of lower extremities were found in almost half of people from the oldest group (table VI).

Injuries of torso were the most common in the groups of the youngest and the oldest people. Severity of injuries rose together with age - from 2.77 ± 2.60 points according to LSO in the youngest group to 3.92 ± 3.15 in the oldest. Thus percentage of patients treated surgically was the highest in the oldest group and rose with age.

The oldest patients required hospitalization in ICU the most commonly and for the longest time. Relatively high hospital mortality was found in the oldest group (5.26%) and rose with age (mortality in the youngest group equaled only 1.17%). However after adding pre-hospital road traffic deaths it was found that mortality related to trauma - except for the youngest group - exceeded 8%.

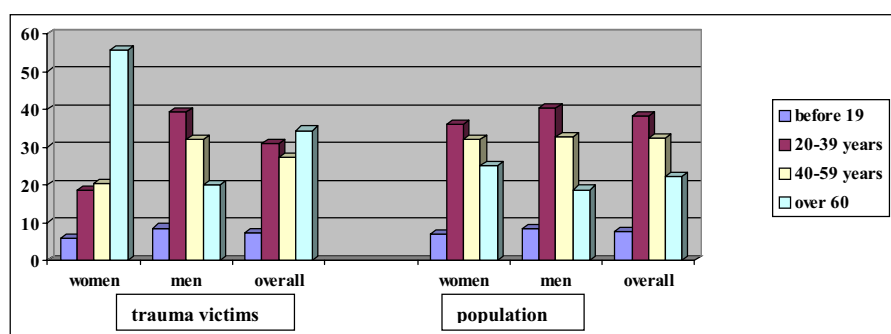
Severity of isolated injuries amounted to on the average 2.73 ± 1.39 points according to LSO. Table VII summarizes general data of patients with regards to severity of isolated injuries. Patients with severity of injuries assessed to be 4 and 5 proved to be the oldest. In all groups but groups of LSO 4 and 5 (with high per-

**Table VII**  
Severity of isolated injuries.

	LSO 1 n=396	LSO 2 n=1387	LSO 3 n=749	LSO 4 n=419	LSO 5 n=240	LSO 6-7 n=54	LSO 10 n=29
Age	44.16 ± 20.98	41.16 ± 19.01	51.76 ± 19.97	66.40 ± 21.45	69.53 ± 12.28		46.69 ± 18.37
Men	253 (63.89%)	882 (63.59%)	451 (60.21%)	180 (42.96%)	87 (36.25%)	45 (83.33%)	23 (79.31%)
Women	143 (36.11%)	505 (36.41%)	298 (39.79%)	239 (57.04%)	153 (63.75%)	9 (16.67%)	6 (20.69%)
Alcohol	82 (20.71%)	169 (12.18%)	108 (14.42%)	33 (7.88%)	14 (5.83%)	19 (35.19%)	20 (68.97%)
Dominating cause	Fall: 141 Aggression: 63 Inside the vehicle: 53	Fall: 587 Aggression: 182 Inside the vehicle: 179	Fall: 422 Wysok: 59	Fall: 298	Fall: 200	Aggression: 11 Pedestrian: 8 Inside the vehicle: 8	Aggression: 5 Pedestrian: 4 Inside the vehicle: 4
head	265	610	91	48	22	33	26
chest	15	51	66	12	7	10	2
abdomen	18	11	6	9	12	2	0
pelvis	13	19	34	5	2	0	0
spine	10	18	71	10	3	8	1
upper extremity	33	255	223	11	1	0	0
lower extremity	42	423	258	324	193	1	0
Operated on*	164 (41.41%)	805 (58.04%)	431 (57.54%)	331 (79.00%)	200 (83.33%)	22 (40.74%)	0
treated conservatively*	232 (58.59%)	582 (41.96%)	315 (42.06%)	88 (21.00%)	40 (16.67%)	11 (20.37%)	1 (3.45%)
Hospitalization time*	3.29 ± 2.76	4.07 ± 3.63	7.58 ± 7.36	13,93 ± 8.26	13.94 ± 7.25	9.73 ± 14.91	1.00 ± 0
ICU stay* - patients	1 (0.25%)	7 (0.50%)	9 (1.21%)	13 (3.10%)	17 (7.08%)	28 (84.85%)	1
ICU stay* - days	1	40 (śr. 5.71)	34 (śr. 3.78)	42 (śr. 4.0)	122 (śr. 7.18)	305 (śr. 10.89)	1
Deaths	1 (0.25%)	2 (0.14%)	8 (1.07%)	23 (5.49%)	16 (6.67%)	52 (96.30%)	29 (100%)
in-hospital	1	2	5	23	16	31	1
pre-hospital	0	0	3	0	0	21	28
for 100.000	0.16	0.31	1.25	3.59	2.50	8.12	4.53
Years of potential life loss	6.26	12.26	145.97	141.77	217.28	869.93	200.80
mean for 1 death	6.26	6.23	18.25	6,16	13.58	16.73	22.31
for 100.000	0.98	1.92	22.81	22,15	33.95	135.93	31.37

\*without patients who died in pre-hospital period

**Figure 2**  
Percentage of women and men according to Age in trauma victims and in general population.



centage of women suffering from fractures of proximal part of femur) men dominated. In most of groups falls constituted the most common mechanism of injuries, but for the least severe and the most severe injuries acts of aggression played important role. Hospitalization time increased with the severity of injuries (with exception of the most severely injured), in common with necessity of ICU stay and its length.

In all groups but LSO 1 most of patients were treated surgically. Mortality

rates rose with age with few worth mentioning deaths that occurred in group LSO 3, and particularly LSO 2 and 1.

Multiple injuries results in the most severe consequences in trauma patients. In comparison of three groups (classified according to the severity of injuries assessed with the use of LSO: below 8 points, 9-15 points and over 15 points) there were no significant differences in age distribution found, but in the group of the least severely injured patients percentage of women was the highest (table VIII).

Road traffic accidents (affecting both car passengers and pedestrians) constituted one of the most common mechanisms of injuries, though in the groups of the least severely injured patients and patients with isolated injuries plain falls were the most common. More than 60% of patients with the least severe multiple injuries were operated on likewise almost all the most severely injured patients who were transported to the hospital alive. Similarly more than 60% of patients with severe injuries and almost all the most

**Table VIII**  
**Severity of multiple injuries.**

	MOC ≤ 8 n=143	MOC 9-15 n=76	MOC >14 n=121
Age	48.66 ± 22.37	43.68 ± 20.31	45.92 ± 18.66
Men	80 (55.94%)	62 (81.58%)	87 (71.90%)
Women	63 (44.06%)	14 (18.42%)	34 (28.10%)
Alcohol	18 (12.59%)	19 (25.0%)	48 (39.67%)
Dominating cause	Fall: 46 Pedestrian: 31 Inside the vehicle: 38	Inside the vehicle: 27 Pedestrian: 24 Fall from height: 12	Pedestrian: 55 Inside the vehicle: 33 Fall from height: 22
LSO	5.71 ± 1.23	12.09 ± 2.09	19.41 ± 1.14
Operated on*	86 (60.14%)	43 (56.58%)	17 (14.05%)
treated conservatively*	57 (39.86%)	9 (11.84%)	1 (0.83%)
Hospitalization time*	10.76 ± 12.52	18.19 ± 22.17	1983 ± 25.24
ICU stay* - patients	5 (4.06%)	31 (59.62%)	18 (100%)
ICU stay* - days	103 (mean 20.60)	387 (mean 12.48)	235 (mean 13.06)
Deaths	2 (1.40%)	46 (60.53%)	118 (97.52%)
in-hospital	2	22	15
pre-hospital	0	24	103
for 100.000	0.31	7.19	18.44
Years of potential life loss	42.62	1628.81	4217.17
mean for 1 death	21.31	35.41	35.74
for 100.000	6.66	254.50	658.93

\*without patients who died in pre-hospital period

severely injured patients who were transported to the hospital alive were treated in ICU. There were only 2 deaths in the group of the least severely injured patients. In the group with "medium" severity of injuries mortality rate amounted to more than 60% (although more than half of those deaths occurred in the pre-hospital period), whereas only 3 patients from the group of the most severely injured survived (2.48%) with 103 (85.12%) of deaths in pre-hospital period (table VIII).

## Discussion

There is a great diversity (from 200 to 800/100.000/year) in regard to the incidence of injuries found in the literature [22-25]. Such huge discrepancy results from different conditioning including various inclusion criteria for the studies. Thus some authors include patients with only minor injuries treated in the out-patient way. On the other hand only few authors include trauma victims who died at the site of accidents. In our study we excluded people who sustained injuries that did not require hospital treatment and people who died at the site of accident but without "true" injuries (so suicides after strangulation, drowned people and people who died due to electric shock

without marked burns). However results obtained proved to be similar to abovementioned [26].

Mortality found in our material also fit to the results found in the literature (1.9-11%). Mortality rate calculated per 100.000 of inhabitants per year oscillates between 40 and 131/100.000/year. Results of our study (mortality rate 46.25/100.000/year) also proved to be similar to the results of other studies [27-29].

Localization of the injury determines its consequences. The highest incidence was found for the injuries of lower extremities (more than 193/100.000/year) in both age groups [30-31]. It's noticeable that distribution of severity of injuries is different in different age groups: in the group of people at the productive age minor and moderate injuries dominate, while in elderly - mostly severe injuries are noted. Character of extremity injury is inextricably related to the mechanism of injury and age of the patient. This confirms authenticity of model of "elderly woman" who due to trivial trauma (usually fall from standing) sustains fracture of neck of femur or pertrochanteric fracture (almost 95% of injuries) in contrast to young patients, who rarely suffer from hip injuries (barely 5.5% of lower extremity injuries) and if so - due to se-

vere trauma (in motor vehicle accidents inside the car, as a pedestrians hit by cars or due to falls from heights). "Sport injuries" also constitute common mechanism of injuries in young people (about 20%). Upper extremity injuries are also more common in young people.

Head injuries constitutes the second most common group of injuries. In the USA they are responsible for about 230.000 of hospitalizations and about 50.000 deaths per year. Moreover more than 90.000 of people after severe injuries become permanently disabled resulting in the group of about 5 millions of Americans requiring help from other people due to head injuries [33]. In our material incidence of head injuries amounted to 170/100.000/year. Such injuries affected 30% of all patients treated because of injuries. In the group of people at the productive age 72% of head injuries were found in men. There was high percentage of intoxication (23.84%) found in those patients.

The most serious consequences resulted from multiple injuries. About 10% of patients included in our study suffered from them, and 73% of multiple injuries were found in the people at the productive age. There was very high mortality rate - 48.82% - found in this group, with 37.35% of deaths that occurred at the site of accident. Road traffic accidents constituted the most common mechanism of injury (61.18%) followed by falls. Thus results obtained in our study are again similar to the ones found in the literature [34].

Overall incidence of injuries of body cavities - chest, abdomen and pelvis - reached 45.95/100.000/year. There were 17 deaths (5.78%) found in this group with highest mortality in patients with chest injuries.

Injuries of those regions together with head injuries determined the final outcome of patients with multiple injuries, though concomitant injuries of extremities contributed to the morbidity and mortality rates. High mortality rate found in our study results from inclusion of pre-hospital deaths. In-hospital mortality rate however remains within values presented by other authors [35,36].

Thus we were able to show that studied parameters (localization and extent of injuries, their severity and age of the patients) should be considered as a basis for creation of appropriate groups of risk in trauma patients.

Obtained results show unequivocally that injuries of extremities, head injuries



and multiple injuries remains leading therapeutic and economic problems. Thus there is still open question regarding creation of reference centers specialized in the treatment of injuries of particular body regions, creation of trauma centers and financing of procedures allowing for the use of newer and more accomplished techniques of diagnosing and treatment of injuries.

## Conclusions

1. Epidemiological data regarding consequences of injuries: incidence, mortality and percentage of patients, who require disability pension calculated for the population representative of Krakow are comparable to the ones found in Polish and worldwide literature.

2. Slight differences in the number of years of potential life and work lost between the study material and data from the literature most probably results from the fact that nowadays more and more trauma victims survive injuries (especially severe ones), thus resulting in increase in the number of people with permanent impairment of the function of organism. Accordingly this results in higher incidence of posttraumatic disability.

3. Influence of localization and severity of injuries, in common with age and gender of the patients, on the course of treatment and final outcome in the study material proved to be undoubted.

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