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STATISTICAL ANALYSIS AND GRADE OF OCCUPATIONAL INJURIES IN THE REPUBLIC OF CROATIA

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SUMMARY: The basic objective of this paper is to investigate the state of work safety in the Republic of Croatia. The total number of injuries at work and the number of fatalities at work were analyzed using the method of descriptive statistics for the period 1996 - 2016. Special attention is paid to the correlation between the number of injuries at work, the number of fatalities and the movement of gross domestic product, total employment and employment by individual economic activities. The results of the research will provide an overview of the basic labor safety trends in the Republic of Croatia and the identification of those industries in which employment trends determine the total number of injuries at work. The results of the research are based on the methods of descriptive statistics and the statistical method of correlation analysis.

Key words: *occupational injury, safety, statistics, work safety*

INTRODUCTION

The decline in the competitiveness of the Croatian economy in several areas has created such structural changes that create imbalances in the Croatian economy, primarily the excessive share of the service sector relative to the manufacturing sector of the Croatian economy (mostly due to the deindustrialization of Croatia). Deindustrialization signifies the process of reducing the meaning of industry in the national economy measured by its share in the gross domestic product, *(Čavrak et al., 2011., 155)*. The process of industrialization in the EU is only partially consistent with the definition of this term. The EU industry has in good part successfully repositioned itself so that the process of restructuring has allowed the abandonment of much of the work-intensive activities in favor of those with a higher level of added value. The cost of these adjustments was reflected in employment, i.e. rising unemployment, with low skilled labor remaining to be a permanent loser *(Teodorović & Buturac, 2006).* In Croatia, the drop in the share of the secondary sector in the recent period of Croatian history is more than obvious. According to data from the Statistical Yearbook of the Republic of Croatia, the share of industry in the social product was 34 % in 1980 and in 1988 by 41 %. In the structure of GDP, the Republic of Croatia's industry accounted for 21.3 % in 2016.

The industry in Croatia has a long tradition and is the foundation of the Croatian economy. The industry according to the National Classification of Economic Activities (NCEA) covers the following areas: B - Mining and quarrying, C - Manufacturing, D - Electricity, gas, steam and air conditioning supplying and E - water supply, sewage disposal, waste management and environment remediation activities.

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In 1990, Croatia had a share of the manufacturing industry in the gross domestic product of 24 %, while in 2015 this share was halved and amounted to only 12 % (Group of authors, 2017). In the manufacturing industry, 75 % of total industry revenue is realized and 84 % of the employed are employed by industry. As of 2010, Croatia is behind of the Central and East Europeans countries when it comes to labor intensity in the manufacturing industry and only Bulgaria has a higher labor intensity share in the manufacturing industry.

Therefore, it is not surprising that the greatest number of injuries at work occur precisely in the manufacturing industry. For example, the number of injuries in the manufacturing industry in the Republic of Croatia in 2016 amounted to 3627 or 22.34 % of the total number of injuries. In the production of food products and production of finished metal products except machinery and equipment, about 37 % of the total number of injuries to work in the manufacturing industry occurs. Behind the manufacturing industry according to the number of injuries at work in the real sector follows the distributive trade with 2339 injuries or 14.41 % and construction with 1143 injuries or 7.04 %. These three economic activities are at the forefront of the number of injuries at work in the real sector. They are followed by transport and storage activities with 978 injuries or 6.02 %, services of accommodation activities and food preparation follow with 806 injuries or 4.96 %, agriculture, forestry and fisheries with 667 injuries or 4.11 % and water supply activities; sewage, waste management and remediation activities with 527 injuries or 3.25 %, electricity supply activities, gas, steam and air conditioning supply with 198 injuries or 1.22 % and mining and quarrying with 22 injuries or 0.14 %.

As expanding economic activities in the 21st century belong first and foremost to the service sector, relationship between the movement of gross domestic product and total employment on one hand and the number of injuries at work on the other is getting weaker. Accordingly, a special subject of research in this paper will be to investigate the link between employment trends and number of injuries at work in the leading three sectors of the real sector by number of injuries at work.

In accordance with the identified and set problem of research and the subject of research in the work, two hypotheses have been set:

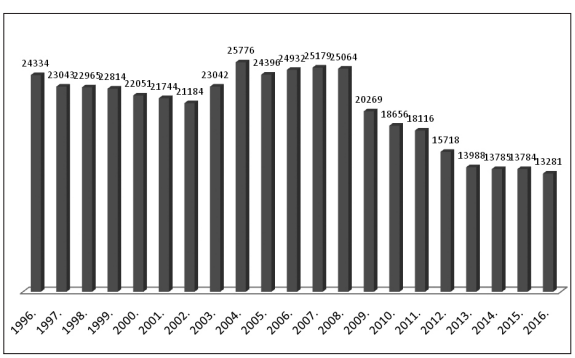
H_1: Due to the increase in the share of the service sector in the structure of the national economy of the Republic of Croatia there is no statistically significant relation between the total number of injuries at work and the movement of gross domestic product, i.e. the trend of total employment.

H_2: There is a statistically strong and positive link between the employment trends in the real sector (manufacturing industry, construction and distribution trade) and the total number of injuries at work.

Results of adopting and implementing the new Occupational Safety Act and all of its changes from 1996 to 2014 are not meant to be diminished in this investigation but to there is a need to point to those economic activities in which the employment movement directly and essentially determines the total number of injuries at work.

ANALYSIS OF THE SAFETY AT WORK IN THE REPUBLIC OF CROATIA

The number of injuries at work in the Republic of Croatia for the period from 1996 to 2016 is shown in Graph 1 *(Pap, 2012, 2015)*.



Graph 1. Number of injuries at work in the Republic of Croatia from 1996 to 2016

Slika 1. Broj ozljeda na radu u Republici Hrvatskoj od 1996. do 2016.

Based on the data collected on the number of injuries at work in the Republic of Croatia, a brief descriptive work safety analysis was carried out for the period from 1996 to 2016 (cf. Table 1).

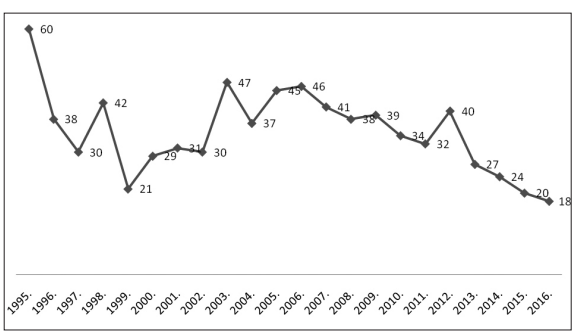
Table 1. Descriptive work safety analysis in the Republic of Croatia from 1996 to 2016

Tablica 1. Opisna analiza sigurnosti na radu u Republici Hrvatskoj od 1996. do 2016.

	BOR
MEAN case 1-21	20672
MEDIAN case 1-21	22051
SD case 1-21	4272
VALID_N case 1-21	21
SUM case 1-21	434121
MIN case 1-21	13281
MAX case 1-21	25776
_25th% case 1-21	18116
_75th% case 1-21	24334

During the period under review, 434 121 injuries were reported in the Republic of Croatia. The annual average number of injuries at work in the observed period is 20 672 injuries (M = 20 672; SD = 4 272). The lowest number of injuries at work was 13 281 and it was recorded in 2016, and the highest number of injuries was 25 776 and was recorded in 2004. Only in the last five years the annual average number of injuries has been lower than 18 116.

Due to work injury in 2016, 18 workers were killed, while in 1995 there were 60 workers or 3.3 times more (cf. graph 2); *(Pap, 2012, 2015)*.



Graph 2. Number of deaths at work in the Republic of Croatia from 1995 to 2016

Slika 2. Broj smrtnih slučajeva na radu u Republici Hrvatskoj od 1995. do 2016.

Based on the data collected on the number of fatalities at work in the Republic of Croatia, a brief descriptive analysis was carried out for the period 1995 to 2016 (cf. Table 2).

Table 2. Descriptive analysis of labor deaths in the Republic of Croatia from 1995 to 2016

Tablica 2. Opisna analiza smrtnih slučajeva na radu u Republici Hrvatskoj od 1995. do 2016.

	BSS
MEAN case 1-22	35
MEDIAN case 1-22	35,5
SD case 1-22	10
VALID_N case 1-22	22
SUM case 1-22	769
MIN case 1-22	18
MAX case 1-22	60
_25th% case 1-22	29
_75th% case 1-22	41

In the observed period in the Republic of Croatia there were 769 deaths at work. The average annual number of fatalities at work in the observed period is 35 (M = 35, SD = 10). The lowest number of deaths at work was 18 and was recorded in 2016, and the highest number of deaths was 60 and was recorded in 1995. Only in five years in the observed period, the average annual number of deaths was less than 29.

INVESTIGATING THE CORRELATION BETWEEN GROSS DOMESTIC PRODUCT AND THE OVERALL EMPLOYMENT RATE AND NUMBER OF INJURIES AT WORK AND THE NUMBER OF DEATHS AT WORK

The Croatian economy after 2008 was exposed to a deep economic crisis. This is supported by the main economic indicators such as gross domestic product and total employment (see Table 3); *(Tomašić, 2015)*.

Table 3. Movement of GDP and employment rates in the Republic of Croatia from 1996 to 2015 (in %)

Tablica 3. Kretanje BDP-a i stope zaposlenosti u Republici Hrvatskoj od 1996. do 2015. (u %)

Year	Movement of GDP	Employment trends	Injuries at work
1996.	5,9	-0,1	8,8
1997.	6,8	-0,6	-5,3
1998.	2,5	7,1	-0,3
1999.	-0,9	-0,7	-0,7
2000.	2,9	6,2	-3,3
2001.	4,4	0,5	-1,4
2002.	5,6	0,8	-2,6
2003.	5,3	2,5	8,8
2004.	4,3	1,1	11,9
2005.	4,3	0,8	-5,4
2006.	4,8	3,4	2,2
2007.	5,2	3,3	1,0
2008.	2,1	2,5	-0,5
2009.	-7,4	-3,6	-19,1
2010.	-1,7	-4,5	-8,0
2011.	-0,3	-1,5	-2,9
2012.	-2,2	-1,1	-13,2
2013.	-1,1	-2,2	-11,0
2014.	-0,5	-1,6	-1,5
2015.	1,6	1,1	-0,01

Gross domestic product and total employment were steadily declining for six consecutive years. According to available statistical data, it can be concluded that GDP is still below the level of 1986. Equally, in the same period, the number of employees in the Republic of Croatia is lower by more than 200 thousand. Thus, in the period of three decades there has been no economic development and this has not happened in the past 200 years of economic history of Croatia *(Domazet, 2013)*. These negative trends were accompanied by a trend of reducing the number of injuries at work. In 1990, there were 44 900 injuries at work and 2016 there was only 13 281, which is 3.38 times less. Accordingly, the purpose of this paper is to investigate the correlation between the movement of gross domestic product, total employment, number of injuries at work and number of deaths at work.

Based on data from Table 3, it is evident that there is an expected link between GDP and employment in the observed period, but also that the expected link between GDP trends, total employment and number of injuries at work is missing. This statement was particularly pronounced in the pre-crisis period. Namely, in just four of 12 years of GDP growth, there has been an increase in the number of injuries at work. This would be encouraging data when it could not be attributed to the structural changes in the economy of the Republic of Croatia, apropos a decrease of the secondary sector share in GDP. Croatia has in principle followed the trend of most transition countries, those in which there was structural adjustment following the de-industrialization process. The structure of the economy is changing in the direction of services. A significant decrease of industry and agriculture share happened in total gross added value. Structural changes in industrial production were largely conditioned by privatization and liberalization processes. The feature of the process is the change of the structure of industrial production to the benefit of the sector with a lower content of added value. Although total production has grown, there has been a great fall in employment in the industry and hence the number of injuries at work.

This statement is confirmed by the results of a correlation analysis between the number of injuries at work, the number of fatalities and the total employment rate and the gross domestic product are given in Table 4.

Based on the data from Table 4 it is visible that a statistically strong and positive correlation exists between the movement of gross domestic product and total employment ($r = 0.89$, $p < 0.05$), and the positive correlation exists between the average strength between the number of fatalities and the number of injuries work ($r = 0.57$; $p < 0.05$). The correlation analysis results do not confirm the existence of a statistically significant correlation between the number of injuries at work and the total employment rate and gross domestic product. The data obtained indicate changes in the structure of employees and

changes in the economic structure of the Republic of Croatia and point to the need for a micro approach to the investigation of the correlation between the number of injuries at work and the number of employees in certain sectors of the real sector and above all to the manufacturing and construction industry together with trade activities that were recognized with the highest recorded number of injuries at work.

with the safety engineer expert. In medium-sized enterprises that make up 1.19 % of the occupational safety occupational structure, the employer is obliged to contract with the occupational safety specialist by a labor contract. A small share of large enterprises with more than 250 employees of all 378 or 0.26 % indicates a small number of employers who are obli-

Table 4. Correlation analysis between the number of injuries at work (NIW), the number of fatalities (NF) and the total employment (TE) rate and gross domestic product (GDP)

Tablica 4. Analiza povezanosti broja ozljeda na radu, broja smrtnih slučajeva i ukupne stope zaposlenosti te BDP-a

Correlations (HR_2018) Marked correlations are significant at p < ,05000 N=20 (Casewise deletion of missing data)						
	Means	**Std.Dev.**	**NIW**	**NF**	**TE**	**GDP**
NIW	21042	4023.56	1.000000	0.573339	0.081380	-0.208119
NF	35	8.04	0.573339	1.000000	0.390207	0.243059
TE	1378022	97196.36	0.081380	0.390207	1.000000	0.895247
GDP	276072	35675.69	-0.208119	0.243059	0.895247	1.000000

INVESTIGATING THE CORRELATION BETWEEN THE NUMBER OF INJURIES AT WORK, THE NUMBER OF FATALITIES AND THE EMPLOYMENT RATE BY INDIVIDUAL ECONOMIC ACTIVITIES

The micro approach to injury investigation at work should provide relevant data on the extent and structure of the Croatian economy. In the context of the micro-exploration approach in Table 5, the structure of enterprises in the Republic of Croatia is shown by the number of employees and economic branches.

The data in Table 5, given that enterprises are real operators of occupational safety measures, point to:

- The dominance of small businesses employing fewer than 49 employees (98.56 %) means that job security is performed by the employer alone or has a work contract ged to contract with a number of occupational safety specialists in the implementation of occupational safety work.
- The dominance of the following economic activities according to the rank: 1) wholesale and retail trade, motor and motorcycle repair, 2) professional, scientific and technical activities, 3) manufacturing industry, 4) accommodation and food service activities and 5) construction industry.

Domination of these activities in the structure of the Croatian economy indicates the justification of the correlation research between the movement of the number of employees in the manufacturing, construction and trade sectors and the number of injuries at work. Data on employment trends in these three economic activities can be found in Table 6 and Graph 3 *(Central Bureau of Statistics of the Republic of Croatia*).

Table 5. Structure of economic potential in the Republic of Croatia in 2014 according to the National Classification of Activities 2007

Tablica 5. Struktura ekonomskog potencijala u Republici Hrvatskoj u 2014. prema Nacionalnoj klasifikaciji aktivnosti iz 2007.

	Total	micro <10	small (10-49)	medium (50-249)	large 250+	Share by company number
Mining and quarrying	245	188	43	11	3	0.17 %
Manufacturing	20087	16784	2526	633	144	13.63 %
Electric power, gas, steam and air conditioning supply	560	506	38	10	6	0.38 %
Water supply; sewage disposal, waste management and environmental remediation activities	845	475	258	99	13	0.57 %
Construction	18359	16774	1343	214	28	12.46 %
Wholesale and retail trade; repair of motor vehicles and motorcycles	37886	35105	2367	329	85	25.71 %
Transportation and storage	8642	7997	505	110	30	5.87 %
Activities of providing accommodation and preparation and serving of food	19532	18244	1148	118	22	13.26 %
Information and communication	6147	5646	428	61	12	4.17 %
Real estate business	3899	3750	136	9	4	2,65 %
Professional, scientific and technical activities	23236	22294	859	75	8	15.77 %
Administrative and auxiliary service activities	6324	5815	403	83	23	4.29 %
Repair of computers and personal and household goods	1575	1538	33	4	0	1.07 %
Total	147337	135116	10087	1756	378	
Relative structure 2014.		91.71 %	6.85 %	1.19%	0.26 %	

Source: Central Bureau of Statistics of the Republic of Croatia, SLJH, 2016., 230

Table 6. Employees in legal entities in manufacturing industry, trade in construction

Tablica 6. Zaposleni u pravnim osobama, industriji, trgovini i građevinarstvu

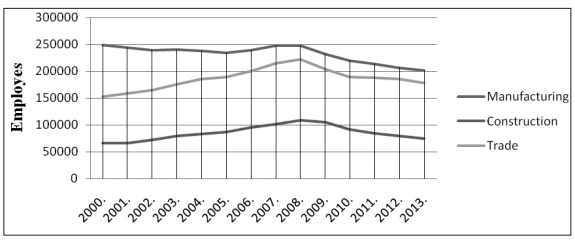
	Manufacturing	Construction	Trade
2000.	249482	65465	152503
2001.	244996	65991	158051
2002.	240084	72077	164155
2003.	240361	78607	175369
2004.	238330	82391	184979
2005.	234804	85732	188675
2006.	239423	94432	200074
2007.	247769	100761	214459
2008.	248853	108260	222153
2009.	232751	104978	203494
2010.	219976	91052	189241
2011.	214302	84194	187645
2012.	207298	78579	185277
2013.	201950	73832	178084

Source: Central Bureau of Statistics of the Republic of Croatia (www.dzs.hr, access 14.12.2017)

Table 7. Correlation analysis for the period from 2000 to 2013

Tablica 7. Analiza povezanosti za razdoblje od 2000. do 2013.

Correlations (Spreadsheet1) Marked correlations are significant at p < ,05000 N=14 (Casewise deletion of missing data)							
	Means	**Std. Dev.**	**Manufacturing**	**Construction**	**Trade**	**NIW**	**NF**
Manufacturing	232884,2	15704,23	1,000000	0,144342	0,036719	0,878520	0,248718
Construction	84739,4	13694,40	0,144342	1,000000	0,961628	0,340807	0,507383
Trade	186011,4	19998,23	0,036719	0,961628	1,000000	0,288463	0,513491
NIW	21436,8	3704,35	0,878520	0,340807	0,288463	1,000000	0,522267
NF	36,9	6,55	0,248718	0,507383	0,513491	0,522267	1,000000



Graph 3. Employees in legal entities in manufacturing industry, trade in construction

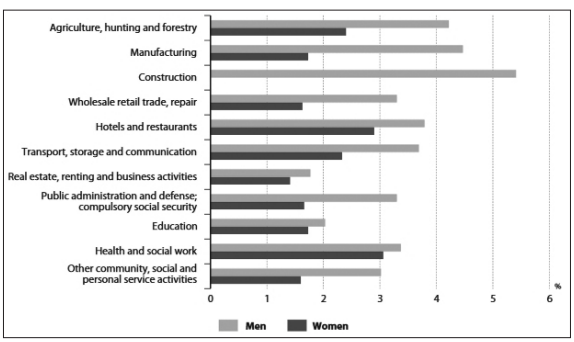
Slika 3. Zaposleni u pravnim osobama, industriji, trgovini i građevinarstvu

Based on the collected statistical data, a correlation analysis was made (cf. Table 7)

The results of the correlation analysis conducted for the period from 2000 to 2013 show a strong correlation only between the employment trends in the manufacturing industry and the number of injuries at work ($r = 0.87$, $p < 0.05$). There was a slight correlation between the number of employees in construction and trade and the number of injuries at work. There was a slight correlation between the turnover of employees in the manufacturing industry and the number of fatalities at work, while the correlation between the movements in the number of employed in construction and trade and the number of fatalities at work is of medium strength.

SOME TECHNICAL INSIGHT OF ACCIDENTS AT WORK

Accident at work is defined as a physical or mental harm that occurred during occupational activity of a person and his trip to and from work place. This data include non-fatal accidents involving more than 3 days of absence from work. A fatal accident is defined as an accident that leads to death of a victim within one year of the accident *(Eurostat, 2017).* Workers in 2007 statistics by Eurostat report for whole European Union show the distribution of injuries by sector (graph 4.); *(Eurostat 2007).* It can be seen that sector with most skilled manual workers often have accidents at work.



Graph 4. Injuries at work in EU for 2007 by sector

Slika 4. Ozljede na radu u EU za 2007. po sektorima

In Eurostat 2007 report it is also noted that accidents at work happen with workers with atypical working hours rather than regular working hours. European Statistics on Accidents at Works how that 70 % of non-fatal accidents resulted from worker losing body control, falling (form greater heights, slipping) or physical stress (uncontrolled body movements) leading to mistakes and small injuries. Whereas fatal accidents and more than 40 % occurred by loss of control and entering in a collision with an object.

Injuries that occur more frequently by Eurostat 2007 are wounds and superficial injuries, dislocations, sprains, concussion and internal injuries, bone fractures which are caused by mechanical dangers. The physical dangers *(Regent, 2015)* like bad lighting, sound, vibration, and drowning or extreme temperatures are less represented but also more difficult to establish. The result of physical dangers are more often categorized as work diseases that affect hands, hearing problems, cardiovascular problems, eyes problems, skin problems, . However they can also seriously affect the occurrence of work accident like a slip in cold weather, cut because of bad lighting, body collision because of bad hearing etc. *(Bognolo et al., 2015, Kršulja et al., 2015)*. The most seriously related health problem that are reported are muscle problems which mainly affect back, followed by other extremities muscle problems and then stress and anxiety mostly caused by fatigue.

In European Union by data provided from Eurostat the occurrence of accidents decreased from 3.5 % in 1999 to 3.3 % in 2007. The decrease between 1999 and 2007 was found in sector of mining, quarrying and construction. While in Croatia the occurrence from 1996 to 2007 had a steady 22000 injuries and more and in 2009 it suddenly dropped to 20 000 and in 2016 it is 13281 it is a drop of 40 % when compared to period 1996 -2007. The occurrence of fatality decreased in European Union from 4 % in 1999 to 2.9 % in 2007. In Croatia from 1995 it was 60 fatalities in 2007 40 fatalities and from 2013 a drop to 27 and 2016 to 18 fatalities, it can be seen as a drop in occurred fatalities of 50 % from period of 1995 to 2013.

CONCLUSION

Between 1996 and 2016, 434 121 occupational injuries were reported in the Republic of Croatia. The annual average number of injuries at work in the observed period is 20 672 injuries or more than twice less than in 1990. After 2009, which marks the beginning of the economic crisis in the Republic of Croatia, there is a noticeable decrease in the average number of injuries at work. The number of fatalities at work shows significant fluctuations over the years, although starting from the outbreak of the economic crisis, there are similar tendencies as well as the number of injuries at work. The statistical analysis carried out confirmed the lack of correlation between GDP trends and total employment on one hand and shows that the reduction in the number of injuries at work in the observed period can be explained by structural changes in the economy of the Republic of Croatia, i.e. by reducing the share of the secondary sector in GDP.

The micro-research approach has confirmed the dominance of micro and small enterprises in the structure of the economy of the Republic of Croatia, which means that the job of protection at work in 98.56 % of Croatian enterprises are done by the employer or they have a contract with a protection expert. The second hypothesis is also confirmed by the dominance of retail and wholesale trade, as well as the manufacturing and construction industry, it has been confirmed by the absolute and relative share in the number of companies. The correlation analysis that was carried confirmed a strong correlation only between the employment trends in the manufacturing industry and the number of injuries at work and the correlation of medium strength between the employment trends in construction and the treasury and the number of deaths at work. So the other hypothesis is only partially proven. Namely, between the employment trends in the real sector (manufacturing industry, construction and distribution trade) and the total number of injuries at work there is a statistically strong and positive correlation ($r = 0.63$, $p < 0.05$). A medium strong and positive correlation was also established between the employment trends in the real sector (manufacturing industry, construction and distribution) and the total number of fatalities at work ($r = 0.55$, $p < 0.05$).

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Zakon o zaštiti na radu, N.N., br. 71/14., 118/14.

STATISTIČKA ANALIZA I OCJENA OZLJEDA NA RADU U REPUBLICI HRVATSKOJ

SAŽETAK: Temeljni cilj ovoga rada jest istražiti stanje sigurnosti na radu u Republici Hrvatskoj. Ukupan broj ozljeda na radu i broj smrtno stradalih na radu predmetom su analize pomoću metode deskriptivne statistike za razdoblje od 1996. do 2016. godine. Posebna pozornost posvećuje se istraživanju korelacije između broja ozljeda na radu, broja smrtno stradalih i kretanja bruto domaćeg proizvoda, ukupne zaposlenosti i zaposlenosti po pojedinim gospodarskim djelatnostima. Dobiveni rezultati istraživanja omogućit će sagledavanje osnovnih trendova sigurnosti na radu u Republici Hrvatskoj te detektiranje onih gospodarskih grana u kojima kretanje zaposlenosti determinira ukupan broj ozljeda na radu. Rezultati istraživanja temelje se na metodama deskriptivne statistike i statističkoj metodi korelacijske analize.

Ključne riječi: *ozljede na radu, sigurnost, statistika, radna sigurnost*

Izvorni znanstveni rad
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