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Analysis of electrical injuries among workers

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Introduction. In the conditions of modern production, there is an increase in electrical injuries among workers. The article deals with the problem of injuries and characteristics of occurrence of electrical injuries in the workplace.

Problem Statement. The purpose of this study is to analyze statistical data and materials for investigating industrial injuries. The aim of the study is to determine the characteristic causes of electrical injuries in the workplace among workers and the main affecting factors.

Theoretical Part. The basic information used is the statistical data on occupational injuries provided by the Federal State Statistics Service.

Conclusion. The results of the analysis indicate that the main causes of electric injuries are organizational and psychophysiological factors. In order to improve safety and prevent injuries among workers, a comprehensive approach to risk assessment is needed, which will allow for the most complete consideration of all factors and conditions that contribute to the occurrence of electrical injuries in the workplace.

Keywords: electrical safety, electrical injury, injury causes, safe working conditions.

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Introduction. Currently, the level of injuries at work remains quite high. It is worth noting that we live in an era of industrial production development and a constant increase in electricity consumption. In modern production, a significant place is occupied by power plants and electric networks. All this creates prerequisites for increasing the risk of electrical injuries among workers. Thus, the study of the causes and factors of occurrence of electrical injuries is very important.

Problem statement. Analysis of statistical data on the state of injuries by industry in 2019 shows that the highest level of injuries is observed in the processing industry — 22.3%, mining — 19.3%, construction — 18.2%, agriculture accounts for 16.8% of cases, transport and communications — 11.8%, electricity — 7.8%, and other industries — 3.8% [1-3]. The distribution of injuries by type is shown in table 1.

The main types of injuries: falling from a height, moving objects, machines and mechanisms, road accidents. They account for up to 70% of all injuries. Cases of electrical injuries account for about 7.4% of injuries, but almost 40% of such injuries are fatal [2, 4-5]. All this, in the opinion of the authors, requires a more detailed study and analysis of the state of electrical injuries both at work and in everyday life.

Table 1

Distribution of injuries by type

Types of injury-risk factors in the production:	%
workers fall from a height	28,2
moving objects, machines, mechanisms	14,1
road accidents	14,4
collapses, objects fall on a person	13,1
electrical injuries	7,4
temperature effects	6,2
processed parts	5,1
toxic exposure, chemical burns	3,4
drowning	2,1
other factors	6,0

Theoretical part. Official Rosstat data for 2019 on electrical injuries are shown in figure 1.

— eye injuries are about 7%. Most often found among adults at the workplace;

— electric burns at home among adults — about 7%, among children — 5%. They account for 4,7% of industrial injuries;

— intracranial electrical injury among children reaches 13%, and among adults —11% [4].

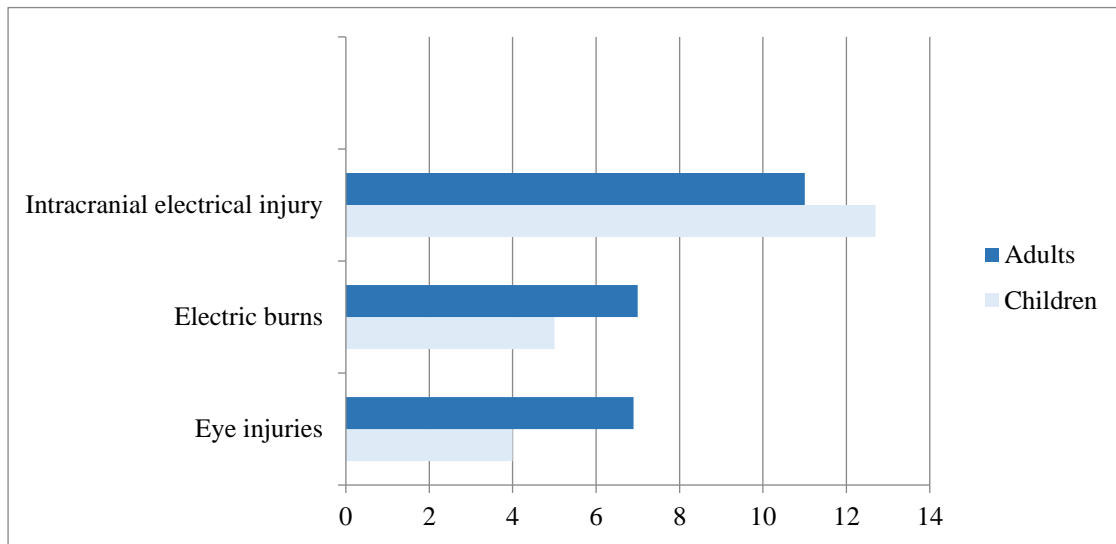


Fig. 1. Distribution of electrical injuries by types of injury

The danger of electric shock in production comes from sources of welding current, electric drives (including starting and control equipment), electrical equipment of lifting and transport devices, automated transport, induction and searchlight installations, electroplating hand-held tools, etc.

Effects of electric current on the human body can lead to various local electrical injuries (electric burn, skin metallization, electric mark and so-called general electric shock [5].

Electrical injury is the impact of electric current on a person with the development of deep functional disorders of organs and systems.

Electric burn is the most common electrical injury. Burns can be caused by an electric arc (arc burn) or contact with a live part (current burn) [2].

Skin metallization occurs in the case of mechanical or chemical current exposure, when inert or molten metal particles penetrate deep into the skin and the affected area becomes a solid surface.

An electric mark is a consequence of a thermal effect when a relatively large current flows through a small surface with a relatively large resistance at a temperature of 50-115°C with a good contact, resulting in coagulated, charred or swollen skin from close contact with live parts [6].

An electric shock leads to irritation of living tissues and is followed by involuntary convulsive muscle contractions when an electric current passes through the human body.

Electrophthalmia leads to inflammation of the outer membranes of the eyes, which occurs as a result of exposure to a powerful stream of ultraviolet rays of an electric arc.

Electric current affects the nervous system. This effect is very pronounced, since when an electric current passes through the body, a huge number of sensitive nerves are affected, the effect of electric current on skeletal muscles is very significant, as it causes spasm, and especially on the heart, causing its fibrillation. Most often, in such cases, death occurs, since the pumping function of the heart stops. Respiratory arrest or burn may also be a cause of death [4].

Influence of current on the human body depends on factors such as the body's resistance, amperage, duration of exposure, frequency and type of current, path of current flow in the body, the body condition and environmental conditions.

All this indicates a specific effect of electric current on a person, which most often leads to serious health disorders and death.

The main causes of electric shock among workers are:

- impact of electric current passing through the welding circuit;
- contact with open live parts and wires (accidental, not due to production necessity or due to incorrect power supply during repair and inspection);
- touching live parts that have a faulty circuit;
- touching parts with voltage through objects with low insulation resistance, metal parts of equipment that are overstressed (due to the absence or damage of protective devices) , etc.

Discussion and conclusion. The analysis of cases of electrical accidents at work have shown that 40-45% of the cases involve violations of the rules of operation of electrical installations, 25-30% of traumas — non-compliance with the safety requirements in the workplace and 30-35% of electrical shocks are caused by irregularities in the design of facilities, poor maintenance, presence of voltage on live parts of electrical installations. All causes are usually divided into technical, organizational, constructive and psychophysiological [7-9].

Thus, the issues of ensuring electrical safety in the workplace are still relevant today. The number of accidents resulting from electrical injuries is quite high, and a significant part of them are fatal. The main cause of electrical injuries is non-compliance with safety requirements. Therefore, in order to reduce the overall injury rates, it is necessary to study in more detail the cases of electrical injuries as a factor affecting the death rate at work [10].

To reduce cases of electrical injuries among workers, it is necessary to:

- improve the level of professional training of employees;
- provide high-quality training of employees in safe techniques and methods of work;
- timely monitor the condition and operability of power supply systems and power plants;
- conduct registration and analysis of psychophysiological causes of injuries as the most likely to occur in electrical injuries.

To ensure the electrical safety of workers, it is necessary to implement a comprehensive approach to risk assessment, which will allow for the most complete consideration of all factors and conditions that contribute to the occurrence of electric injuries [8]. Studying and solving problems related to ensuring healthy and safe working conditions is one of the most important tasks for the development of the economy and production in Russia. Comfortable and safe working conditions are one of the main factors affecting labor productivity, safety and health of employees.

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S. L. Pushenko — scientific supervision, analysis of research results, revision of the text, correction of conclusions; E. V. Staseva — formulation of the main concept, goals and objectives of the research, calculations, preparation of the text, formulation of conclusions; S. G. Demchenko – specification of the purpose and objectives of the research, calculations; S. Y. Nasonova — work on the text, conclusions, calculations; A. N. Tengaeva — work on the text, conclusions, calculations.