

WORK ACTIVITIES AT INCREASED RISK OF TRAUMATIC INJURIES: AN INTEGRATED PREVENTIVE APPROACH

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ABSTRACT

Included in the scope of workplace safety is that relating to potential accidents, i.e. the harmful consequences for human health crossed with the work environment factor. In the study of the determinism of these accidental events, it is important to achieve a biomechanical balance between two main elements: the human and the work environment (consisting of the physical, chemical and environmental factors, i.e. the equipment and what generates its use). Considering the most recent statistically recorded incidents, our analysis has focused on the accident sphere proper, where an imbalance in the above-mentioned binomial triggers the activation of multiple disciplines that actively and pro-actively study the event and assess its sequelae, in all possible facets (economic, engineering, clinical, medical-legal).

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1. Introduction

The basis of occupational safety studies in the field of accidents lies in ergonomics, a scientific discipline that focuses on the mechanisms of human work; this, in continuous interaction with other disciplines such as general medicine, occupational medicine, physiology, psychology, sociology, physics and technology, idealises the best possible adaptations of the man-machine-work environment system, taking into account, of course, the individual capabilities and psycho-physical limitations of man. [1].

Underpinning these foundations must be consolidated and dynamic risk assessment, management and communication processes. The assessment represents perhaps the most granitic element and is present in all the stages mentioned as it plays the role of a multi-purpose tool for the employer, enabling both the identification of suitable prevention and protection measures and the planning of their implementation and, where necessary, their correction. [2, 3]

In the ideal model the risk assessment is carried out both qualitatively and quantitatively; however, this is not always possible and so, with reliance on scientific and statistical-epidemiological data, the more complex aspect to be assessed relating to the psycho-physical impact of the activity carried out and the epigenetic profile of the individual worker is left out. [4, 5, 6]

A risk classification is solely on the basis of objective elements commonly available in each environment [7, 8, 9], such as: height, surface area, volume, lighting (ordinary and emergency), flooring (regular or uneven), type of walls (plain or equipped), internal and external viability (and in light of this, the need for any manual handling of loads), floors (stability), mezzanines (intended use, practicability, tightness, load-bearing capacity), hatches (visible and with safety locks), exits (sufficient number depending on the number of staff), doors (sufficient number depending on the number of staff), underground rooms (dimensions, air changes). [10, 11, 12].

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Similar consideration is given to the serious risks associated with machinery and equipment with regard to the protection of starting, transmission, working and control parts, the presence or absence of the 'CE' mark, protection in the use of lifting equipment, lifts and hoists, pressure equipment, access to tanks, reservoirs and similar places. [13, 14, 15]

The result of this risk assessment process and the choice of the most suitable prevention and protection procedures and measures for the type of work to be performed will be set out in the Risk Assessment Document (DVR), which will be periodically updated and kept by the employer.

[16, 17, 18, 19]

Based on the type of risks listed in the DVR, the employer will prepare the health surveillance service, i.e. the set of all medical acts for the protection of the health of employees. Specifically, a doctor specialising in occupational medicine will be appointed who will draw up the Health Protocol, the document that sets out the first level instrumental examinations such as audiometry, spirometry, visiotest or electrocardiogram, laboratory tests and medical examinations with the relative periodicity, which will be used by the specialist to assess the suitability of workers for the specific task. [20, 21, 22, 23, 24]

2. The type of working environment

When it comes to safety risks, it is necessary to understand which areas should be considered. For example, for a worker in construction [25], a farm labourer [26], a warehouse worker or worker in the food industry [27] or, again, in healthcare, especially in this pandemic period, [28] it is necessary to reckon with a high risk of occupational injuries. It must be equally clear that the consequences can range from a trivial sprain to permanent inability to work and even a fatal outcome.

Among the data that must necessarily be taken into account are: the age group (tending to be between 50 and 54, where about 74,960 accidents are recorded), the construction sector (31,027 complaints), the wholesale, retail and vehicle repair sector (34,501 complaints), the warehousing and transport sector (31,361 complaints), the health and social work sector (25,501 complaints), the metal products manufacturing sector (17,940 complaints), the machinery manufacturing sector (10,597 complaints) and the food industry sector (8,373 complaints)[29].

The data that give an idea of the depth of the phenomenon are, of course, the statistical ones; however, an in-depth analysis could reveal that prevention is not always, as it seems, to be implemented in objective terms, but rather in subjective terms, since many accidents may also be due to the psycho-physical state of the worker. [30]

A media example of an accident in the textile industry is that of L.D.O. [31], a young worker who died because she was sucked into the warping machine of a textile factory. Investigations carried out on the equipment revealed two critical points:

1. The photocell, which ensures the closure of the instrument in the presence of the operator, was absent from the structure of these. This would mean that the instrument was not up to standard, and;
2. the job description was not that of a worker but that of an apprentice. This would imply additional responsibilities for the employer since an apprentice could not work with equipment.

In the construction sector, too, a more detailed investigation must be carried out in order to be able to arrive at the so-called *root cause analysis*, i.e. that process of identifying the starting point of a problem in order to devise and implement suitable solutions to avoid it. [32, 33]

Construction is, in fact, the sector with the highest risk of fatal accidents and occupational accidents which mainly concern specialised construction activities (62.2 %) and building construction activities (30.8 %).

The most frequent injuries are contusions (24.7 per cent), dislocations and sprains (24.2 per cent), fractures (21.2 per cent); while the most affected body parts are the hand (33.4 per cent), leg (27.7 per cent) and head (18.3 per cent). [34]

The most typical example of an accident in this area is precipitation injuries, which can have two underlying causes: one related to the working environment, with unsuitable support structures, and the other related to the worker's correct use of specific safety equipment, such as harnesses [35, 36].

The frequency of these accidents testifies that it is necessary to go beyond mere formal requirements such as training and information and, rather, towards an integrated approach tending towards a *worker-oriented* model. Among other sectors with a high accident rate is the food industry, for which a question must be asked: is it to be considered a direct or indirect risk? With 50,000 companies and more than 400,000 employees, the Italian food industry is worth about EUR 140 billion (8% of the gross domestic product). Injuries such as contusions, sprains and wounds (often from cuts), in most cases caused by machinery, are also very frequent in this sector. [37]

In particular, in the bakery sector, 38% of the injured persons were between 35 and 49 years of age and the hand and fingers were the most stressed and most injured parts (33% overall).

Moreover, out of about 150 accident cases, one means of transport is involved each year, often operated by self-employed 'padroncini' who escape INAIL protection.

SARS CoV 2 infection contracted in the workplace is a frequent cause of accidents [38, 39]. It has long been debated whether this event and hence the associated biological risk from SARS CoV 2, in a non-healthcare workplace, should be considered a generic or job-specific risk. The most accredited opinion in the scientific community is to frame this condition as an aggravated generic risk, which does not derive from the organisation set up by the employer or which must necessarily manifest itself in that organisation, but rather uses the organisation and the complex system of personal relationships to manifest itself and spread, coming from outside the organisation itself. [40]

4. Analgesics administered under the supervision of the anesthetist

Often, the polytraumatised person is in such a state of agitation that the doctor is unable to make a careful diagnosis. In such cases, sedative drugs are administered along with molecules with analgesic activity. Commonly used molecules include Ketamine, a parenteral anaesthetic agent with analgesic activity at sub-anaesthetic doses. It is a drug with antagonist activity on N-methyl-D-aspartate (NMDA) receptors with activity on opioid receptors [41-43]. This molecule, at a dose of 0.25-0.5 mg/kg i.v. is able to produce rapid and intense analgesia. Molecules such as the synthetic opiate fentanyl, which is about 75 times more potent than morphine, can be decisive if the patient does not present a state of intense agitation. In this case, it is desirable to combine analgesic therapy with drugs with anxiolytic or sedative activity as an adjuvant.

Among these molecules we can mention midazolam, a centrally acting benzodiazepine capable of inducing drowsiness, muscle relaxation and short-term memory loss, and propofol useful both for sedation and for inducing deep anaesthesia [44-46]. As an alternative to these drugs, drugs capable of inducing loco-regional anaesthesia may be considered [47-49].

3. New categories of working environments

With this in mind, it seems relevant and topical to deal with a very special category of work such as that of the *rider*. For these figures, given the peculiarity of the type of work, it must be understood whether they can incur either an accident on the way to work or an accident related to the elective risk of the task performed [41].

In fact, as is well known, accident data from the last five years have shown that road accidents are among the most common causes of accidents, followed by falls on the ground. In no case did it emerge that the riders had been subject to health surveillance and none of the companies had carried out the assessment of the risks related to the working activity of the riders; in this sense the effects of the type of working shift, together with the consumption of substances that, especially in the evening, may be common in meals, such as alcohol, should not be underestimated (it should be noted that riders, in shifts, carry out activities almost 24 hours a day). [42, 43, 44]

At the same time, however, riders, irrespective of their employment contract, were guaranteed social security protection and insurance against accidents, injuries, damage to third parties and sometimes even in the event of death [45, 46].

With regard to training, specific training courses were provided, for example, on traffic regulations. In addition, the knowledge of the Italian language and the correct understanding of the training content in the case of foreign workers was verified.

In terms of individual protection, considering the increase in this activity during the pandemic period, some companies provided riders with the classic PPE (helmet, high-visibility jacket or jersey, lights and mobile phone holder), as well as Sars-CoV-2 anti-contagious devices (face shield, masks, gloves, disinfectant gel) [47]. The means of transport (bicycle or scooter) is, in most cases, the responsibility of the rider himself, which also raises doubts regarding the insurance profiles of the means. There is also no clear line on the maintenance of the means of transport: some companies have left the maintenance of the means of transport to the worker, while others have provided for company contributions/contributions for maintenance [48].

In some areas of the Italian state, initiatives aimed at safety education with specific regard to the professional figures of riders have also been promoted by the Health Protection Agency [49].

From a regulatory point of view, however, it should be clarified that, since most of them are self-employed or parasubordinate workers, the protections provided by Legislative Decree 81/08 are very limited or difficult to apply to this category of workers. In any case, the results obtained make it possible to provide guidance to companies on the measures they should follow to protect the health and safety of their workers [50, 51, 52].

Returning to global data, according to INAIL, the logistics sector employs more than one million people and, in general, the warehousing and transport sector is in line with the construction sector in terms of risk of occupational injury or disease. Considering that what affects logistics most today is the time factor, the following critical issues emerge, which contribute to an increase in accidents in recent years [29]:

- incorrect postures
- repetitive efforts
- tight work rhythms
- sitting for long periods while driving
- handling of loads leading to musculoskeletal disorders
- nervous system disorders
- falls
- crush injuries

Among the lifting and transport equipment with the highest accident rates are forklift trucks. Injuries caused by 'lifting and transport equipment' (forklifts, pallet trucks, etc.) are among those that contribute most to the number of serious and fatal accidents [53]. Among the various causes contributing to the occurrence of such damaging events are:

- lack of or incorrect definition of transit routes for forklifts and pedestrians
- none or insufficient driver protection
- non-standard forklifts (brakes, buzzers, etc.)

From a strictly critical point of view, however, it should also be made clear that such equipment is certainly the most incorrectly used and lacks the most elementary safety measures [54, 55, 56].

Take, for example, the accident that occurred to the driver of a fork-lift truck while moving material inside the warehouse, who fell with the truck from the loading platform of the warehouse from a height of approximately 1 m. The driver was thrown from the driver's seat and was subsequently found by the emergency services lying on the floor of the yard with his head wedged under the left rear wheel, resulting in a crushing polytrauma. In the fall, the person was thrown from the driver's seat and was subsequently found by the emergency services lying on the floor of the yard with his head wedged under the left rear wheel, resulting in a crushing polytrauma and head injury [57, 58, 59].

Among the most researched but equally relevant sectors in terms of accidents is the school sector. School accidents show how one of the causes to be kept in mind could be the exuberance of children, amplified by the possible abuse of alcohol and psychotropic substances [60]. For example, in 2017, INAIL received more than 80,000 reports of injuries which occurred in public and public schools, and the most affected body parts are the hands and ankles mainly affected by:

- dislocations;
- distortions and distractions;
- bruises;
- fractures;
- injuries.

From the strict point of view of insurance, while students are protected against accidents occurring during activities or practical exercises, there remains a flaw in the approach to safety and the real perception of risk by such young people [29, 34].

4. Work-related stress

The term work-related stress has a broad meaning involving the psychological and physical aspects of the worker [61, 62]. In purely physical terms, it is to be understood as stress suffered by the organism when carrying out work activities. However, this aspect, too, has considerable repercussions on the psychic sphere of the subject with residual impairment [63].

In this sense, multiple factors insist on organic stress; one of the main ones being working hours, and this in relation to physiological cortisol levels. Numerous studies, in fact, report a different compliance of response to micro- and macro-trauma, depending on the time of day and intensity of effort, in competitive and amateur athletes [64, 65]

In certain work activities, certain repeated gestures or particular biomechanical conditions risk subjecting our skeleton to functional overload stress, which cannot always be absorbed by our muscles, leading to a particular type of fracture known as a 'stress fracture' [66, 67].

In terms of stress, it is necessary to carry out a broader examination that also allows us to precisely analyse the link between work activity and the pace to be sustained. However, when it becomes excessive and continuous, it can result in the manifestation of physical and emotional symptoms that affect quality of life and work performance. Stress is not an illness per se, but a condition caused by external factors that impact on the worker's capabilities. Thus, we speak of work-related stress when it is caused by the continuation of factors inherent to the work context and content: too intense and disproportionate to the worker's capabilities [68, 69].

In this sense, the development of work-related stress symptoms can develop into pathology and have negative effects on both the individual and the company:

- decline in the worker's performance;
- increase in accidents caused by human error;
- absenteeism;
- post-traumatic stress syndrome;
- Negative attitudes [70].

These are some of the factors that represent an increase in costs for a company and the progressive degradation of the working environment: a situation that can be prevented and reduced if the appropriate and correct work-related stress risk assessment and management methods are applied. In Europe, for example, one in five workers in their profession operate on a shift-based schedule. This is a type of employment that does not follow the conventional 6/8 hour working period but is characterised by night, rotating or irregular shifts [71].

This organisation of work and in particular night work pose health risks and are 'primary' stressors for many categories. One only has to think, for example, of workers on an assembly line, restaurant workers or supermarket clerks, where there is uninterrupted activity over a 24-hour day, which is increasingly common in the service sector today.

Of particular relevance is the case of professionals employed in healthcare such as doctors and nurses. The case of Sara Viva Sorge's fatal accident is certainly emblematic. The nurse at 6 a.m., after finishing her second consecutive night shift at the rehabilitation clinic, got into her car to drive home. On the way home, about 15 kilometres away, her car crashed into a lighting pole along the provincial road and she died instantly [72].

According to initial investigations, the car may have skidded as a result of

the woman's sudden loss of sleep before ending up running into the pole. Among the hypothetical causes of this fatal accident is undoubtedly an excessive workload and lack of adequate recovery. In addition, it must also be considered how a newly recruited employee was immediately thrown into the middle of a complicated work situation, managing up to 28 patients alone per shift.

5. Workplace violence: 'atypical' injury.

Injuries occurring in the workplace, during the performance of one's work duties, as a result of a violent cause attributable, however, to the action of a third party, are of no small importance [73].

Health care remains at the centre of the rising statistics in terms of serious injuries also for an atypical but unfortunately growing risk [74].

The *National Institute of Occupational Safety and Health* (NIOSH) defines workplace violence as '*any physical aggression, threatening behaviour or verbal abuse that occurs in the workplace*' [75].

Acts of violence most often consist of events with a non-life-threatening outcome, i.e. aggression or attempted physical or verbal aggression, such as that carried out with the use of offensive language.

Workplace violence refers to events where workers are threatened, assaulted or abused in work-related situations, and which pose a risk to their safety, well-being or health. The health and social services sector is among those at greatest risk [76]. In health care settings, violence towards workers is predominantly perpetrated by patients or their relatives. The risk factors can be classified into:

- organisation;
- characteristics of the operator (communication skills, experience);
- patient and family characteristics (socio-economic level, past history of violence).

The percentage of injuries due to violence out of the total number of injuries shows no significant differences over time for any geographical area (North, Centre and South). There is still a higher occurrence of events in the North-West macro area, where violence accounts for 8.8% of the total number of injuries in healthcare.

The frequencies by age group show that healthcare workers subjected to assaults do not show any significant differences in the age distribution compared to injured healthcare workers as a whole.

Unfortunately, it has been recorded that physical assaults are more frequent towards women, who are involved in almost 73% of the cases. The highest number of events has always been recorded in hospitals, but the gradual strengthening of territorial care has led to a steady increase in events in the territory: in the last period, also due to the pandemic, almost 60% of the events concerned the territory. These differences are therefore not a consequence of an increase in the risk in general of territorial centres, but of the reduction in the use of hospitalisation and the greater burden of care on the territory.

With regard to the job description, the most affected category is that of health care workers (57.9% of victims of violence). This is followed by nurses (23.5% of the victims of violence), while the share of doctors remains constant (12.4% of the victims of violence). assaults on medical and nursing staff occur mainly in hospitals, while assaults on auxiliary staff occur mainly in residential and social care facilities.

From the point of view of insurance, about 9% of accidents result in more than 40 days' prognosis (without permanent incapacity) while 8% suffer permanent incapacity for work [77].

The most frequently coded mode of violence is:

- 'violence, aggression, threats - from persons outside the company towards the victims within the framework of their function' (about 50% of the events)
- 'presence of the victim or a third party who creates a danger to the victim/self and, where appropriate, to others' (about 20%);
- "surprise, fright, violence, aggression, threat, presence - unspecified" (about 15%)
- "violence, aggression, threats - between company employees" (about 15%).

6. Conclusions

The above demonstrates that the basis of risk assessment must include both a consultation of multiple disciplines that do not overlap but complement each other, and the interaction of the various professional figures that deal with the issue of safety in the workplace; the final outcome of which builds that starting point for a study, a posteriori, of the improvement of complex safety and prevention systems. The emergence of new work activities and therefore of new types of occupational risk, requires a different approach also in terms of health assessment and surveillance aimed at filling the knowledge gaps in the understanding of the impact of new environmental and occupational risk factors on health, promoting new models that reduce the incidence of negative consequences on the psycho-physical well-being of workers.

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