

OCCURRENCE OF OCCUPATIONAL ACCIDENTS IN THE VALE DO AÇO REGION, MG, BRAZIL

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ABSTRACT

This study aimed to analyze the incidence of occupational accidents in the Steel Valley Metropolitan Region (RMVA), Minas Gerais, Brazil, for the two years between January 2021 and December 2022. The database used was the information contained in the Communication of Work Accidents (CAT) of all injured workers assisted by the Reference Center for Worker's Health Care (CEREST) based in the city of Ipatinga. After analyzing the information, the relationships between the number of claims and the main variables (type of work accident, hours worked, number of days off work, and regions affected) were established. The study showed that typical accidents were predominant, corresponding to 71.00% of all events, explaining the relationship between the lack of training and the unsafe conditions existing in the workplace. Moreover, it was identified that 71.79% of occupational accidents involved injuries that subjected the victims to prolonged periods of leave for health treatment. The findings showed a similar pattern at the national level. However, there are also possibilities regarding the under-registration of CATs. This limitation can be attributed to accidents requiring less than fifteen days away from work. In general, for this type of accident, the underreporting of accidents may be greater than among those with more days away from work. In addition, the findings pointed out the need to improve the methods related to the design and execution of actions pertinent to worker protection, thus favoring socioeconomic development.

Keywords: Accident at work; Severity; Prevention; Education.

INTRODUCTION

The International Labor Organization (ILO) reports that accidents at work represent significant losses related to public health, such as work leaves, manifestations of pain that can be chronic, emotional suffering, family problems, mental and behavioral disorders, and deaths. In addition, they imply a considerable cost since, besides impoverishing the workers and their families, they imply a drop in productivity, reduced capacity to work, and a drastically increased health expense. From this perspective, the ILO estimates an annual loss of 4% of the gross domestic product (GDP) worldwide as a result of occupational accidents (ILO, 2020).

The situation in Brazil, specifically, is considerably grave. The country ranks fourth in occupational mortality, behind only China, India, and Indonesia (ILO, 2020). In addition, the national reality shows a lack of studies to analyze and interpret the factors that influence or increase the risk of workers suffering an injury, thus hindering the assertive treatment of this serious public health problem. The scarcity and inconsistency of information on the real situation of occupational risks and their repercussions on workers' health compromise the definition of priorities for public policies and the planning and implementation of measures capable of providing effective protection of the health of exposed individuals (Diniz, Pinheiro, and Proietti, 2015).

In addition, several scientific studies show that the information on the statistics of occupational accidents occurring throughout the Brazilian territory is not complete, either in terms of quantity or even qualitative aspects of the events. It is estimated that underreporting reaches values above 70% for fatal accidents and 90% for non-fatal accidents (Sá, Gomide, and Sá, 2017). There are several factors related to this reality, including the professional's assessment that the situation or injury is not risky; factors such as unawareness of the obligation to notify the accident, lack of time due to the excessive pace of work, or even fear of dismissal by workers, in addition to another issue that contributes to underreporting, i.e., the limitation of the Social Security information system, which ends up being restricted only to employees with a record card, covered by Work Accident Insurance (SAT) (Pinto, 2017).

In this context, the main objective of this study was to evaluate the occurrence of occupational accidents among professionals in the Metropolitan Region of Vale do Aço (RMVA), Minas Gerais, Brazil. The database was produced based on the information in the Communication of Work Accident (CAT) of each accident victim assisted by the Reference Center for Worker's Health Care (CEREST) located in Ipatinga, Minas Gerais, Brazil. The research used the descriptive statistics technique between January 2021 and December 2022. The analyses prioritized identifying the accident

group, temporal distribution, time of leave, morbidities, and mortality.

It is understood that the disclosure of the results of this study should motivate managers (municipal, state, and federal) to improve public policies for worker protection with more effective inspection of companies, providing opportunities for advances at the collective level.

FUNDAMENTAL CONCEPTS

The legal concept of occupational accident in Brazil is defined by Law No. 8,213/1991. According to this law, three distinct groups are identified: typical accidents (group I), commuting accidents (group II), and occupational diseases and work-related illnesses (group III).

Group I consists of accidents that occur at work at the company's service and cause bodily injury or functional disturbance that causes death, loss or a permanent or temporary reduction of work capacity. Group II includes accidents occurring during the commute from home to work or work to home and during meal times. Group III covers all the pathologies triggered by work-related life (Law No. 8,213/1991).

Specifically, group III includes occupational diseases, defined as those inherent or peculiar to some branches of activity (Mendes, 2003). The second group includes work-related diseases (WMSDs), defined by the World Health Organization as other conditions that, in addition to legally known occupational diseases, occur in workers when the environment or conditions significantly contribute to the occurrence of diseases, in varying degrees of magnitude (Associação Brasileira de Saúde Coletiva, 1991). This specific group is widely discussed in the scientific literature. For example, Laurell and Noriega (1989), Dejours (1987), and Caldas *et al.* (2015) mention several illnesses attributed to the precariousness of work organization, such as premature aging, pathological fatigue syndrome, sleep disorders, libido alterations, and chronic stress. The researchers also list as sources of these illnesses the hardship factors, such as the exacerbation of mental demands resulting from complex memorization, fragmentation of work, insufficient explanations, and the psychic load resulting from the pressure of work concentration, the pressure of change, and the unhealthy conditions.

In addition, the referred legislation establishes that it is the company's legal obligation to notify accidents at work by filling out the proper documentation, called Work Accident Communication (CAT), until the first business day after the accident, regardless of whether the worker was absent from work or not. In the case of death, this communication

must be immediate. Failure to comply with the legislation can lead to the company's punishment through a fine (Law No. 8.213/1991).

These accidents are also classified into accidents without lost time (SPT) and accidents with lost time (CPT) based on the period of return of the worker to their usual work activities, respectively on the same day or the next day at their usual time, and with an absence of more than twenty-four hours. It is noteworthy that accident events are related to the existence of quite diversified labor risks, which can be biological, ergonomic, physical, mechanical (accident risks), and chemical, requiring the adoption of more efficient practices regarding prevention methods (Jackson Filho *et al.*, 2013; Rocha, Pistolado, and Diniz, 2021).

MATERIALS AND METHODS

The Regional Reference Center for Workers' Health Care in Ipatinga (CEREST/Ipatinga), Minas Gerais, Brazil, is a public agency linked to the Ministry of Health (MS), which has as its direct manager the Municipal Health Department (SMS) of the Municipality of Ipatinga (PMI). This agency acts in accident prevention by making inspections in companies that provide the opportunity to issue technical reports to reduce occupational accidents and formalize occupational risk management practices. In addition, it forms a safety culture by carrying out training activities for companies, health units, schools, the self-employed, and other economic segments. Thus, the dynamics of CEREST/Ipatinga prioritize surveillance and assistance to injured workers, which can include

complementary treatments such as orthopedics, physiotherapy, and neurology, according to the orientation of the first-aid doctor.

The coverage area of CEREST/Ipatinga includes all municipalities of the Metropolitan Region of the Steel Valley (RMVA) (**Figure 1**), better known as the Steel Valley. This is a Brazilian region in the interior of the state of Minas Gerais, in the southeast region of the country, and encompasses the cities of Coronel Fabriciano, Ipatinga, Santana do Paraíso, and Timóteo (National Forum of Metropolitan Entities, 2022).

In this study, a survey of the accidents in RMVA was carried out through a documental analysis of the CEREST/Ipatinga database between January 2021 and December 2022. For this investigation, a specific form was developed to collect the data in the CAT, and several characteristics related to those accidents were determined. The application of descriptive statistics enabled the analysis of the data and allowed the investigation of the following criteria:

- Accident group (typical, commuting, professional or occupational illness);
- Time of work leave;
- Temporal distribution (day of the week and month);
- Mortality;
- Aggravation (area of the body affected).

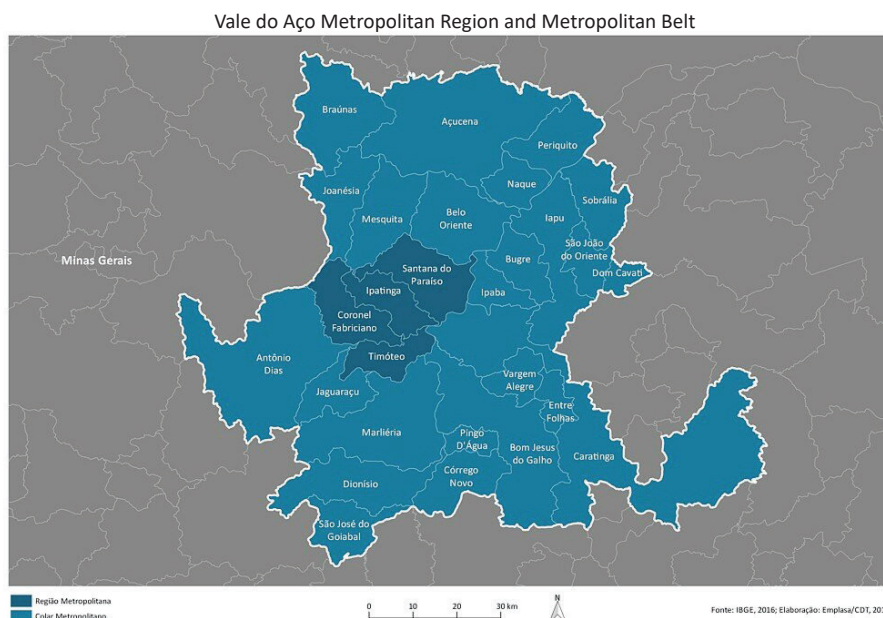


Figure 1. Map highlighting the Steel Valley Metropolitan Region (RMVA), Minas Gerais, Brazil

Source: FNEM (2022), available at: <https://fnembrasil.org/regiao-metropolitana-do-vale-do-aco-mg/> (access on: Jun 06, 2022)

RESULTS AND DISCUSSION

The findings of this research allowed the identification of the preponderance of typical accidents, representing 71.0% of all events (**Figure 2**) for the research period between January 2021 and December 2022 and explaining the relationship with unsafe acts and conditions existing in the workplace. It is considered that these findings are consistent with the statistics of the Ministry of Labor (MT), which show the precariousness of the work environment, thus subjecting employees to the risk of falls, intoxication with unhealthy materials, shocks, prolonged working hours, and non-compliance of protective equipment, among other adverse situations (Cardella, 2014; Oliveira, 2003).

It is considered that a high incidence of accidents is related to the prevalence of errors in conducting tasks at work, and this situation cannot be ignored (Cardella, 2014). Thus, investments are needed in training workers. In this case, it is about the formative actions directed to the efficiency of people in carrying out their duties, qualifying as an essential piece in the process of organizational development (Queiroz *et al.*, 2017). Specifically, adequate planning is required so that training can ensure the effective achievement of objectives. These activities can occur in a short or long format and must be performed with systematic and organized strategies (Chiavenato, 2002; Milkovich and Boudreau, 2000).

Further, it was found that commuting accidents represent 21.0% of the accidents (**Figure 2**). This fact means a progressive connection between workers' exposure to the route conditions, making significant the interaction between urban violence and the displacement of workers (Santos, 2007).

The work accidents characterized as diseases corresponded to only 8% (**Figure 2**). It is noteworthy that, in the current scenario, there are still difficulties in establishing the causal or technical link between the disease and the workers' current or past activity, which is the starting point for the correct diagnosis and therapy but mainly for adopting actions within the health system (Antoniolli *et al.*, 2017). In this regard, an effort is identified within the actions developed to train professionals and enable better understanding and investigation of illness, thus enabling the issuance of CAT (Almeida *et al.*, 2015).

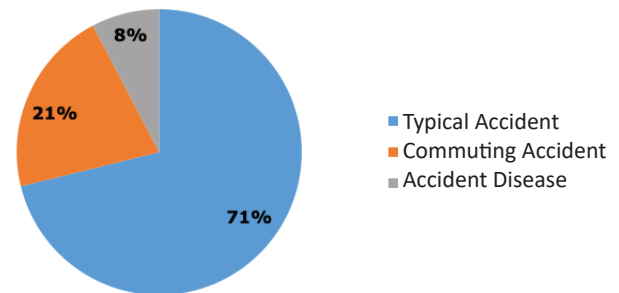


Figure 2. Representation of the prevalence of occupational accident groups. Source: Prepared by the authors by processing the CEREST/IPATINGA report data

Of the registered accidents, 84.50% were lost-time accidents (LTAs) and, therefore, implied injuries that subjected the exposed workers to leaves of absence to treat the accident's after-effects. On the other hand, 10.50% of the accidents were events workers returned the same day or the following day at their usual and permanent time to carry on their work activities (**Figure 3**). Under any condition, these accidents directly impact productivity due to several factors. For example, when occurred on the company's premises, accidents can affect all co-workers who witnessed it. Furthermore, lost-time accidents can reach extremely severe levels and may lead to retirement due to disability or death (**Figure 3**). Thus, until the employee's return or replacement, the company's internal processes will be impacted by the lack of manpower, reducing productivity and hindering the achievement of deadlines or established goals (Rocha, Pistolado, and Diniz, 2021).

Although a corresponding percentage of 10% was identified for accidents classified as SPT (**Figure 3**), it must be considered that the accident underreporting rate is still high in Brazil, notably for this type of event and occupational diseases (Queiroz, Queiroz, and Queiroz, 2017; Queiroz *et al.*, 2021).

In the current scenario, the Public Ministry of Labor (MPT), in an initiative coordinated across Brazil by the Coordination for the Defense of the Work Environment (CODEMAT), is promoting public hearings to guide, inform, and raise awareness among employers on the relevance and mandatory nature of the information and penalties for companies and public health professionals who neglect this obligation (Marques, 2018).

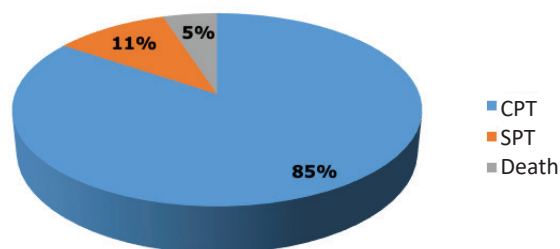


Figure 3. Representation of the percentage of accidents with CPT, SPT, and death

Source: Prepared by the authors by processing the data from the CEREST/IPATINGA reports

Updated data from MPT's Occupational Safety and Health Observatory show that accidents related to the formal labor market in Brazil grew by 30% on average in 2021 compared to 2020. The results of this study also show the same growth pattern but lower, corresponding to 22.8%. The distribution of accidents regarding the months of the year showed a higher frequency in December 2021 and 2022 (**Figure 4**). Although there is no statistically significant difference compared to the other periods, the higher number of accidents in December may be due to the higher volume of service because of the end-of-year holidays.

Regarding the distribution of accidents along the days of the week, it was found that Monday and Friday had the highest number of accidents in the study period (**Figure 5**). We ponder the significant contribution of commuter accidents. These days are atypical in traffic: on Monday, many workers are tired from the weekend activities and wake up later, while on Friday, many want to start their weekly holiday soon; therefore, instead of taking public transportation,

many opt for their vehicle. These situations intensify urban traffic and increase the accident probability (Lozovey *et al.*, 2017). These findings reinforce the relevance of starting the workday by encouraging prevention as a strategy to reduce the number of occupational accidents. It is considered that, at the beginning of the work cycle, it is necessary to stimulate the adoption of safe behavior by, for example, applying the Daily Safety Dialogue (DSD), which, due to its characteristics of dynamism and restricted period for application, reaches good acceptance among workers and employers (Vale *et al.*, 2018). Cabral Júnior (2002) points out that this method of disseminating knowledge on safety and improving risk management programs is generally observed more rigorously in larger companies with over 100 employees, thus reducing the frequency and severity rates of accidents. It is reinforced that it is necessary to expand these tools to smaller companies as well, bearing in mind that prevention contributes to reducing the aggravation and economic impact of accidents since several studies show that the cost of these measures is lower than the cost of repair.

Regarding typical accidents, it was noted that the periods with the highest number of accidents occurred between 7.1 and 8 hours (end of the workday) (**Figure 6**). These findings can be attributed to the prolonged exposure time to occupational risks and suggest that the workers' fatigue favored the propensity to accidents (Cabral Júnior, 2002). In addition, accidents that occurred during a work period longer than eight hours due to overtime were also identified (**Figure 6**). It is argued that Brazilian legislation allows the possibility of excessive work, including harmful and dangerous activities, which increase the wear and tear caused by contact with these adverse conditions, even though it requires prior authorization from the inspection authority, which, for this very reason, should only be granted in absolutely exceptional situations.

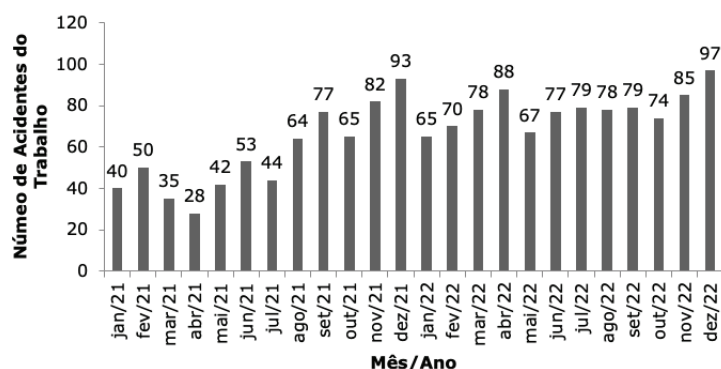


Figure 4. Representation of the number of accidents per month in 2021 and 2022

Legend: Jan/21; Feb/21; Mar/21; Apr/21; May/21; Jun/21; Jul/21; Aug/21; Sep/21; Oct/21; Nov/21; Dec/21; Jan/22; Feb/22; Mar/22; Apr/22; May/22; Jun/22; Jul/22; Aug/22; Sep/22; Oct/22; Nov/22; Dec/22.

Source: Prepared by the authors by processing the data from the CEREST/IPATINGA reports

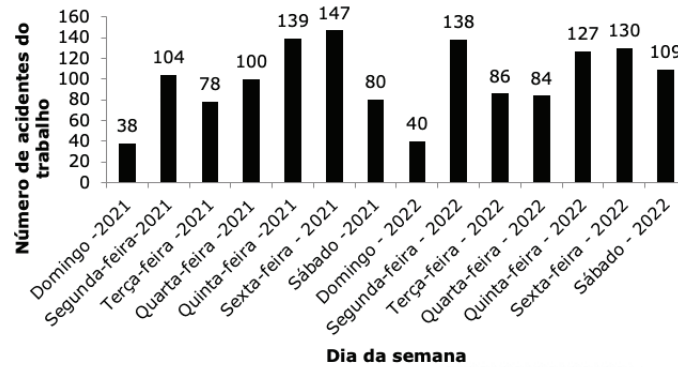


Figure 5. Representation of the total number of accidents counted on each day of the week in 2021 and 2022

Legend: Sunday – 2021; Monday – 2021; Tuesday – 2021; Wednesday – 2021; Thursday – 2021; Friday – 2021; Saturday – 2021; Sunday – 2022; Monday – 2022; Tuesday – 2022; Wednesday – 2022; Thursday – 2022; Friday – 2022; Saturday – 2022.

Source: Prepared by the authors by processing the data from the CEREST/IPATINGA reports

However, in practice, the protection system is not effective since overwork has become common, i.e., overtime is commonly identified in several companies. It is considered that employees often see the possibility of increasing their monthly earnings with the perception of the additional payment, while the employer sees it as normal conduct to ensure productivity and profit generation (Brandão, 2017).

However, production may even decrease. It is necessary to explain that the agents that harm the employee's health are diverse. In this case, it is essential to consider that the fatigue caused by the overload motivated by work activities increases the probability of accidents. Many times, overtime can be pointed out as the trigger of these accidents. In these situations, the excess of hours worked causes occupational stress, fatigue, feelings of weakness, a lack of energy, and exhaustion. A reversible reduction of the body's capacity and a qualitative degradation of work can occur caused by a complex set of factors whose effects are cumulative (Vieira and Russo, 2019). Scientific reports indicate that exhaustion caused by physical or mental overwork may be responsible for an autointoxication condition through the release of leucamins in the brain, increased lactic acid in the muscles, increased creatinine in the blood, and decreased nerve endurance, i.e., conditions conducive to accidents. In the long term, it is believed that it constitutes a contributory condition to developing disorders and injuries, subjecting workers to occupational accidents classified as occupational diseases (Zorzanelli, Vieira, and Russo, 2016).

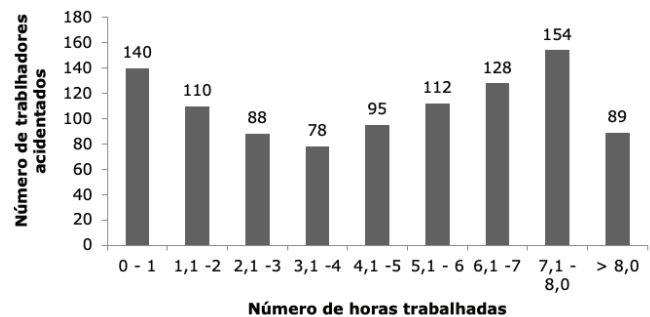


Figure 6. Representation of the number of typical accidents and hours worked

Legend: 0 – 1; 1.1 - 2; 2.1 - 3; 3.1 - 4; 4.1 - 5; 5.1 - 6; 6.1 - 7; 7.1 – 8.0; > 8.0.

Source: Prepared by the authors by processing the data from CEREST/IPATINGA reports

Figure 7 shows the days of absence from work due to accidents classified as CPT. It was noted that 62% of the injured workers had absences of more than fifteen consecutive days. In these cases, the workers must be supported by the National Institute of Social Security (INSS), which, through medical expertise, will determine whether or not to grant the benefit request. In this condition, an aggravating factor refers to the delay pertinent to the performance of the expert procedures, which has repercussions for the delay in the concession of the accidental social security benefit. Besides the individual's loss of capacity, this reality is aggravated by the drop in purchasing power. This worker often uses loans, credit cards, or the overdraft limit with very high interest rates to support his expenses (Berger *et al.*, 2007).

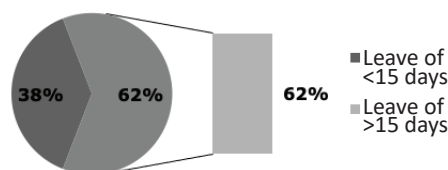


Figure 7. Representation of the percentage of accidents at work with lost time and periods away from work

Source: Prepared by the authors by processing the data from the CEREST/IPATINGA reports

Table 1 presents the distribution of accidents according to the region of the body most affected. In 569 accidents, equivalent to 40.6%, the upper limbs were the most affected body parts, with more severe injuries to the hands. This result is higher than the one found by IBGE, corresponding to 35%. However, the causes indicated are similar, showing a relationship mainly with handling sharp objects. Evidently, this type of accident can have minor consequences; however, it can lead to the loss of workers' limbs with severe and long-term deleterious effects (Ministério da Fazenda, 2017).

Furthermore, it was also verified that the lower limbs were affected in 24.0% of the accidents (**Table 1**). Several contributing scenarios related to these accidents were identified, such as the worker falling due to floor conditions, overstress when lifting or pushing an object, falling parts, and projections from machines that hit this region of the body, among other possibilities. The possible damaging effects include bone fractures, which can also severely harm other tissues, including the skin, nerves, blood vessels, muscles, and other organs. These injuries can become complicated, causing temporary or permanent problems (Gabira *et al.*, 2019). Likewise, it was observed that approximately 13.0% (**Table 1**) of the accident victims suffered multiple injuries, which does not mean that they are more severe than the other accidents; however, it may indicate a prolonged recovery time. In this situation, most accidents with multiple injuries (about 60%) included head, neck, face, and abdomen or pelvic regions. In general, polytraumatized accident victims or those with multiple injuries in the same body segment are in a situation that worsens the prognosis, requiring emergency evaluation by surgical teams (Giugni *et al.*, 2022). In this situation, in the RMVA during the study period, motorcycle accidents stood out with a high morbidity and mortality rate.

Rocha, Pistolado, and Diniz (2021) point out that the incidence of accidents among motorcycle riders has shown significant growth due to the increase in the circulating fleet. The researchers reinforce that the injuries detected in these accidents often require prolonged treatment and, consequently, have repercussions on social security benefits for implying absences longer than fifteen days.

The events that affected the spine and lumbosacral region corresponded to 4.6% (**Table 1**), constituting a risk of severe trauma that can lead to quadriplegia. The most critical situations attributed to commuting accidents were also detected there.

Table 1. Distribution of accidents according to the most affected body region

Body region most affected	Number of Accidents	Percentage
Upper Limbs	569	40.6%
Lower limbs	334	24.0%
Head and neck	180	12.8%
Spine and lumbosacral region	65	4.6%
Thorax and abdomen	70	5.0%
Multiple injuries	182	13.0%
Total	1400	100%

Source: Prepared by the authors by processing data from CEREST/IPATINGA reports

As highlighted by Almeida *et al.* (2014), there is a lack of care for the injured on duty, constituting a challenge that requires improvement in the assistance provided by the Unified Health System (SUS), which presents several difficulties, such as a lack of resources, overcrowding, and a lack of beds. It is considered that improvements are necessary to contain the social, environmental, and economic impacts pertinent to the occurrence of these accidents.

CONCLUSIONS

This study found that the communications of occupational accidents represent a registration system that allows access to various information related to these events. However, the documented information is usually not sufficiently explored, hindering the design of strategies that enable improvements and, consequently, the reduction of morbidity and mortality rates attributed to occupational accidents.

The findings of this study showed the prevalence of typical accidents with lost time related mainly to unsafe conditions existing in work environments, such as non-compliance of machines, equipment, and facilities, a lack of adequate protection, insufficient maintenance, and a slippery floor. In addition, these results were also influenced by the occurrence of unsafe acts practiced by workers, such as non-compliance with the requirements pertinent to risk analysis and a lack of use of PPE.

Thus, investments in worker training present themselves as an essential tool for prevention, reducing the negative

economic and socio-environmental impacts related to labor accidents. This is a proactive action regarding management, implying a significant contribution to public health in Brazil.

The findings of this work also indicated that CEREST/Ipatinga should intensify its inspection and educational actions, contributing to the clarification of uninformed concepts about the dynamics and prevention of occupational accidents.

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