ESPERGESIA
REVISTA LITERARIA Y DE INVESTIGACIÓN
https://doi.org/10.18050/esp.2014

Universidad César Vallejo

Artículo Original

# Occupational Accidents and Production Levels in the Technical Areas of Drinking Water and Sewerage Companies in Manabí, Ecuador

## *Accidentes laborales y niveles de producción en el área técnica de las empresas de agua potable y alcantarillado, Manabí-Ecuador*

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Fecha de recepción: 17.07.2025
Fecha de revisión: 22.10.2025
Fecha de aprobación: 08.12.2025

Cómo citar: Cedeño Vélez, V & Bello Parra, R. (2025). Occupational Accidents and Production Levels in the Technical Areas of Drinking Water and Sewerage Companies in Manabí, Ecuador. *Espergesia, 12*(2), e120208. https://doi.org/10.18050/rev.espergesia.v12i2.4251

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**Abstract**

The objective was to assess the relationship between the frequency and types of occupational accidents and production levels, as well as to identify the main associated risk factors. The research was conducted using a quantitative approach, with a descriptive-correlational design. The information was collected through structured surveys administered to department heads of occupational safety and health in public companies within the sector, and the data obtained were analyzed using descriptive and inferential statistical techniques. The results showed that falls (35%), blows from objects (28%), and exposure to hazardous substances (22%) were the most common types of accidents. An inverse relationship was also identified between accident frequency and production levels, with a higher number of incidents associated with a significant decrease in productivity. Organizational factors such as peaks in activity, workload, and insufficient training in safety were identified as determining factors in the occurrence of accidents. It was concluded that the implementation of preventive measures, ongoing training, and the strengthening of occupational health and safety management contributed to a reduction in occupational accidents and an increase in production levels. The study provides relevant empirical evidence for decision-making aimed at improving occupational safety and operational efficiency among companies in the sector.

**Key words:** Occupational accidents; occupational health and safety; occupational hazards; production levels; public companies; preventive management.

**Resumen**

El objetivo fue evaluar la relación existente entre la frecuencia y los tipos de accidentes laborales y los niveles de producción, así como identificar los principales factores de riesgo asociados. La investigación se desarrolló bajo un enfoque cuantitativo, con un diseño descriptivo-correlacional. La información fue recopilada mediante encuestas estructuradas aplicadas a jefes departamentales de seguridad y salud ocupacional de empresas públicas del sector, y los datos obtenidos fueron analizados mediante técnicas estadísticas descriptivas e inferenciales. Los resultados evidenciaron que las caídas (35 %), los golpes con objetos (28 %) y la exposición a sustancias peligrosas (22 %) constituyeron los tipos de accidentes más frecuentes. Asimismo, se identificó una relación inversa entre la frecuencia de accidentes y los niveles de producción, observándose que un mayor número de incidentes se asoció con una disminución significativa de la productividad. Factores organizacionales como los picos de actividad, la carga laboral y la insuficiente capacitación en seguridad fueron señalados como determinantes en la ocurrencia de accidentes. Se concluyó que la implementación de medidas preventivas, la capacitación continua y el fortalecimiento de la gestión de seguridad y salud ocupacional contribuyeron a la reducción de la siniestralidad laboral y al incremento de los niveles de producción. El estudio aporta evidencia empírica relevante para la toma de decisiones orientadas a mejorar la seguridad laboral y la eficiencia operativa en las empresas del sector.

**Palabras clave:** Accidentes laborales; seguridad y salud ocupacional; riesgos laborales; niveles de producción; empresas públicas; gestión preventiva.

## INTRODUCTION

Traditionally, occupational accidents have been a matter of collective concern, presenting significant challenges for management due to the complexity of operations and limited availability of resources. However, despite legislative advances, various problems persist, including non-compliance with current regulations and resistance to the implementation of new changes. To adequately protect workers in public enterprises, it is essential to adopt a comprehensive approach and promote a strong and sustained safety culture. Chen & Li (2020) describe occupational accidents as unforeseen and unwanted events that occur in the workplace and result in physical or psychological injuries. These accidents are often caused by unsafe behaviors and hazardous working conditions.

Occupational accidents are associated with conditions, characteristics, or exposures that cause harm or damage to workers' health. Therefore, it is necessary to identify the types of risks present in companies in order to prevent accidents, incidents, or occupational diseases (Salcedo, 2022).

According to data from the International Labor Organization for 2023, it is estimated that approximately three million people die each year as a result of accidents and illnesses related to the workplace. The organization also notes that nearly 395 million workers worldwide suffer non-fatal work-related injuries. These figures highlight the magnitude of occupational risks to which workers are exposed and underscore the urgent need to implement effective occupational safety and health strategies. Adopting such measures is crucial to reducing the incidence of accidents and occupational diseases, ensuring safe and healthy work environments (International Labor Organization [ILO], 2023).

Occupational hazards refer to the many dangers that can arise in the workplace and can cause illness and affect workers emotionally and physically. It is therefore extremely important to identify and manage these risks in order to ensure a safe working environment and protect the health of employees. Active prevention and the implementation of appropriate controls are essential to mitigate the adverse effects associated with these occupational hazards, thereby promoting safe and healthy working conditions.

In its report on the health outlook for workers in Ecuador for the period 2021-2022, the Ecuadorian Ministry of Public Health [MSP] (2022) highlights the importance of addressing occupational accidents in the construction sector, given that this field presents significant risks, such as falls from heights, blows from moving objects, accidents with heavy machinery, and exposure to hazardous materials. These events can cause numerous traumatic injuries, such as fractures, amputations, and even loss of life. In this regard, a detailed analysis of these accidents provides a clearer understanding of the challenges faced by workers in this sector.

According to Jiménez and Rodríguez (2021), as a result of the expansion of the services market and the process of globalization, psychosocial risks in the workplace have increased and intensified. There is, therefore, growing attention to these types of risks, which requires a more precise definition of their various manifestations. In this way, the aim is to ensure a more comprehensive approach to occupational health, which is why it is crucial to pay special attention to psychosocial factors and risks.

A study conducted by Célleri Pacheco & Peñaloza Parra (2018) at the Municipal Public Company of Telecommunications, Drinking Water, Sewerage, and Sanitation in the city of Cuenca it was found that the population analyzed presented a high level of ergonomic risk, with a significant percentage of workers located in the very high and high-risk categories, specifically 88% in the drinking water area and 93.3% in the sewerage area. The study also confirmed the effectiveness of the REBA (Rapid Entire Body Assessment) method for identifying risk factors, highlighting its usefulness as a tool for guiding the implementation of preventive and corrective measures in the workplace.

Choudhry (2014), in his research on construction safety, defines occupational accidents as incidents that interrupt the flow of work and cause physical harm to workers. The author emphasizes the importance of safety practices and organizational culture as key elements in preventing this type of accident.

During the period between 2020 and 2021, the Ecuadorian Social Security Institute (IESS) (2021) documented a total of 10,821 occupational accidents in Ecuador, highlighting the pressing need to strengthen occupational safety measures in the country. These incidents not only had a negative impact on the health and well-being of workers, but also affected the economic viability of companies. This research paper proposes to comprehensively examine the occupational risks present in drinking water and sewerage companies in Manabí, using a scientific approach to identify and understand the underlying factors that contribute to the occurrence of these incidents.

Risk management plays a crucial role at the organizational level, as its proper administration contributes to a process-oriented approach, the efficient use of resources, cost minimization, and the consolidation of a culture geared toward strengthening internal control (Guerrero Aguilar *et al*., 2020).

Based on the report by the Ecuadorian Social Security Institute (IESS) (2021), 811 occupational accidents were recorded in the province of Manabí during 2021, which is highly relevant information for this research. These data allow for a clearer identification of patterns and areas of risk, facilitating the analysis of underlying causes and the evaluation of the safety measures implemented. Based on this background, it is recommended that occupational safety strategies be strengthened both in the province of Manabí and at the national level (Ecuadorian Social Security Institute [IESS], 2021).

Investigating occupational accidents in the technical area of drinking water companies is essential to ensuring safe and healthy working conditions. This task not only contributes to the protection of workers, but also ensures the continuity and efficiency of the service, by identifying the most frequent types of accidents and analyzing their impact on the production levels of these companies. Likewise, the identification and mitigation of risks promotes the creation of a more stable and positive work environment, which translates into higher levels of satisfaction and commitment on the part of employees. Aguilar-Pérez & Cruz-Covarrubias (2023) emphasize the importance of timely detection of risk factors and the design of prevention strategies aimed at minimizing their impact. In this context, the present research aims to evaluate the impact of occupational accidents on production levels in the technical area of drinking water and sewerage companies in Manabí.

## METHODOLOGY

This research adopted a quantitative approach with a descriptive-correlational design, which allowed for the analysis of the relationship between occupational accidents and production levels, as well as the identification of the main associated risk factors. The study was descriptive and correlational in nature. According to Creswell & Creswell (2021), the purpose of descriptive research was to characterize the phenomena or conditions studied, while correlational research sought to establish relationships between variables. In this case, the types and frequency of occupational accidents were described and correlated with production levels in the technical areas of the companies evaluated.

The main method used was quantitative, based on the collection of numerical data that was subsequently analyzed using statistical procedures, with the aim of identifying patterns and relationships between the variables studied (Saunders *et al*., 2023). The use of this approach allowed for an objective assessment of the impact of occupational accidents on production, providing reliable and accurate information.

The main technique used was a structured survey, designed to be applied to the occupational health and safety department heads of the drinking water and sewerage companies in the province of Manabí included in this research. The surveys allowed for the collection of information related to the frequency and types of occupational accidents, as well as the risk factors identified in the technical areas (Bryman, 2020). Data analysis techniques were also applied to correlate the results obtained with the production levels recorded before and after the accidents occurred (Field, 2020).

Questionnaires specifically designed for structured data collection were used as instruments. The questionnaire was administered via digital platforms such as Google Forms, which facilitated the data collection process (Gill *et al*., 2019). Statistical software such as SPSS

was used to analyze the information collected, generating tables and figures that made it possible to visualize the relationships between occupational accidents and production levels.

Data collection was carried out in two clearly differentiated methodological phases. In the first phase, structured surveys were administered to departmental heads of occupational health and safety, who were the primary source of information on the incidence of occupational accidents that occurred during the previous year (Colombian Ministry of Labor and Ibero-American Social Security Organization [OISS], 2013). This procedure was based on methodologies previously validated in similar studies, such as those developed by the National Institute for Occupational Safety and Health [INSST] (2012) and the Occupational Safety and Health Administration (OSHA, 2023), agencies that have established guidelines for the collection of information on occupational safety and health. In the second phase, historical data on production levels in the affected areas were collected and analyzed, allowing for a quantitative assessment of the impact of occupational accidents on productivity. Subsequently, the data underwent inferential statistical analysis in order to identify significant correlations and relevant trends in occupational accidents and their impact on organizational performance (Hair *et al*., 2020).

The methodology applied in this research combined the use of surveys, data analysis, and statistical techniques, which allowed for accurate results on the relationship between occupational accidents and production levels in the technical areas of drinking water and sewerage companies in the province of Manabí.

In order to meet the objectives, specific tools and techniques were designed to ensure systematic and accurate data collection. In this regard, the entities responsible for drinking water and sewerage management in the different cantons of the province of Manabí were classified. It was found that some of these institutions operated as municipal agencies and lacked an organizational structure that included areas specializing in occupational safety and health. This aspect was a key element of the study, given that it directly influences occupational risk prevention practices. Accordingly, the research focused exclusively on cantons with formally established companies, as these had the organizational units necessary for a detailed technical analysis. This methodological delimitation allowed for a rigorous evaluation of management practices and the mechanisms implemented in the area of occupational safety and health, providing a more accurate view of their impact on production levels (Jiménez Contreras & Figuera Ávila, 2025).

Below is a breakdown of the entities selected by cantón, considering their organizational and operational structure.

**Table 1.**
*Selection of drinking water and sewerage companies in Manabí*

| Cantón | Responsible Entity | Type of Entity |
|---|---|---|
| Pedernales | Empresa Pública Municipal de Agua Potable y Alcantarillado (EPMAPA-PED) | Public Enterprise |
| Paján | Empresa Pública Municipal de Agua Potable, Alcantarillado y Residuos Sólidos de Paján | Public Enterprise |
| Jama | Empresa Pública Municipal de Agua Potable y Alcantarillado de Jama (EPMAPA-JAMA) | Public Enterprise |
| Manta | Empresa Pública Municipal de Agua Potable y Alcantarillado (EPAM EP) | Public Enterprise |
| Portoviejo | Empresa Pública Municipal de Agua Potable y Alcantarillado (Portoaguas EP) | Public Enterprise |

| | | |
|---|---|---|
| Chone | Empresa Pública Municipal de Agua Potable y Alcantarillado (Aguas del Chuno EP) | Public Enterprise |
| Jipijapa | Empresa Pública Municipal de Agua Potable y Alcantarillado (EPMAPA EP) | Public Enterprise |
| Tosagua | Empresa Mancomunada de Agua Potable y Alcantarillado (EMMAP EP) | Public Enterprise |
| Bolívar | Empresa Mancomunada de Agua Potable y Alcantarillado (EMMAP EP) | Public Enterprise |
| San Vicente | Empresa Mancomunada de Agua Potable y Alcantarillado (EMMAP EP) | Public Enterprise |
| Junín | Empresa Mancomunada de Agua Potable y Alcantarillado (EMMAP EP) | Public Enterprise |
| Bahía de Caráquez | Empresa Mancomunada de Agua Potable y Alcantarillado (EMMAP EP) | Public Enterprise |
| Rocafuerte | Empresa Pública Municipal de Agua Potable y Alcantarillado (EPAPAR EP) | Public Enterprise |
| Jaramijó | HIDROJAR Empresa Pública Hidrosanitaria de Jaramijó | Public Enterprise |
| Puerto López | Empresa Pública Municipal de Agua Potable y Alcantarillado (EPMAP) | Public Enterprise |
| Pichincha | Empresa Pública Municipal de Agua Potable y Alcantarillado (EPMAPAP) | Public Enterprise |

## RESULTS

### Frequency and types of accidents

In this first stage of the study on occupational accidents in drinking water and sewerage companies in the province of Manabí, relevant information was collected based on the frequency and types of accidents that occurred in the different entities analyzed. The data showed that, in general terms, the occurrence of occupational accidents was mainly concentrated in the categories “occasionally” (once or twice a year) and “rarely” (once a year or less).

**Table 2.**
*Accidents occurring in the technical area of drinking water and sewerage companies in Manabí*

| Enterprise | Frequency of accidents |
|---|---|
| EMMAP EP | Occasionally |
| EPAM EP - Manta | Rarely |

| | |
|---|---|
| EPAPAR EP - Rocafuerte | Rarely |
| Portoaguas EP - Portoviejo | Occasionally |
| Aguas del Chuno EP - Chone | Occasionally |
| EPMAPA-PED | Occasionally |
| Hidrojar EP | Occasionally |
| EPMAP EP - Puerto López | Rarely |
| EPMAPAP EP - Pichincha | Rarely |
| EPMAPA EP - Aguas Jipijapa | Occasionally |
| EPMAPA-Jama | Occasionally |
| Empresa Pública de Paján | Occasionally |

***Note:*** *The data was taken from surveys conducted with department heads at each of the drinking water and sewerage companies in Manabí.*

With regard to the results obtained, it was found that the main occupational accidents in the technical area of the companies analyzed were falls, blows from objects, and exposure to hazardous substances, highlighting the need to strengthen safety and prevention measures in the sector.

Falls were the most frequent type of accident, accounting for 35% of recorded cases, with a total of 53 incidents. This behavior was mainly associated with working at height and the presence of uneven surfaces. Companies located in the cantons of Manta (EPAM EP), Portoviejo (Portoaguas EP), Rocafuerte (EPAPAR EP), Jama (EPMAPA-Jama), Paján (Empresa Pública de Paján), and Pedernales (EPMAPA-PED) had the highest incidence of this type of accident, suggesting the need to reinforce the use of personal protective equipment and implement more rigorous safety procedures.

Blows with objects ranked second in incidence, with 42 reported cases (28%). This type of accident highlighted workers' constant exposure to tools, machinery, and moving parts, underscoring the importance of strengthening prevention strategies and training programs focused on safe equipment handling. In this case, the cantons that recorded this type of accident were Jipijapa (EPMAPA EP), Pichincha (EPMAPAP EP), and Tosagua (EMMAP EP).

Likewise, exposure to hazardous substances ranked third, with 33 cases recorded (22%), reported in the cantons of Bahía de Caráquez (EMMAP EP), Junín (EMMAP EP), San Vicente (EMMAP EP), and Bolívar (EMMAP EP). These results highlighted the need to implement specific training, ensure the proper use of personal protective equipment (PPE), and establish clear protocols for the safe handling of hazardous materials.

Furthermore, injuries associated with physical exertion accounted for 10% of cases, with a total of 15 reports, indicating the presence of less frequent but equally relevant risks, especially in activities related to manual loading. In this regard, the incorporation of occupational ergonomics measures may have contributed to the reduction of this type of incident. The affected cantons were Jaramijó (HIDROJAR EP) and Puerto López (EPMAP).

Finally, the category labeled "others" included seven cases (5%), corresponding to less frequent accidents, such as electric shocks, which also required attention to prevent unexpected events. These cases were identified in the cantons of Pichincha (EPMAPAP EP) and Tosagua (EMMAP EP).

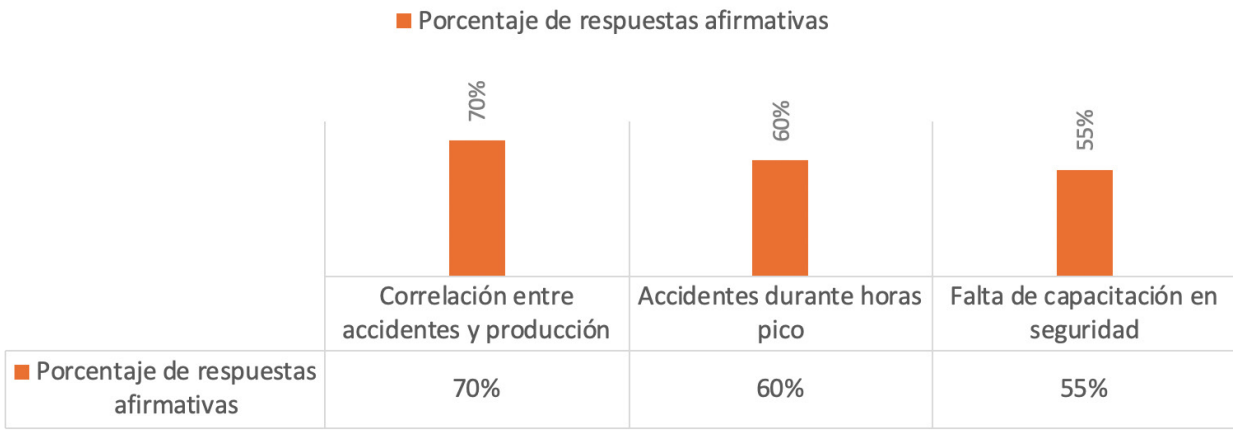
**Table 3.**
*Distribution of accidents by type, company, and canton.*

| Type of Accident | Cases | % | Affected Businesses |
|---|---|---|---|
| Falls | 53 | 35% | EPAM EP - Manta, EPAPAR EP - Rocafuerte, Portoaguas EP - Portoviejo, EPMAPA-PED, EPMAPA-Jama, Empresa Pública de Paján |
| Blows with Objects | 42 | 28% | EMMAP EP, EPMAPAP EP - Pichincha, EPMAPA EP - Aguas Jipijapa |
| Exposure to Hazardous Substances | 33 | 22% | EMMAP EP (Bahía de Caráquez, Junín, San Vicente, Bolívar) |
| Injuries from Physical Strain | 15 | 10% | HIDROJAR EP (Jaramijó), EPMAP (Puerto López) |
| Others (includes electric shocks) | 7 | 5% | EPMAPAP (Pichincha), EMMAP EP (Tosagua) |

### Analysis of the survey of department heads

At this stage of the study, patterns and relationships between the frequency and types of occupational accidents were identified based on production levels. The analysis was conducted using the results obtained from a survey administered to the heads of occupational health and safety departments at drinking water and sewerage companies in the province of Manabí.

**Figure 1.**
*Relationship between accident frequency and production levels*




***Note:*** *The data was taken from surveys conducted with department heads at each of the drinking water and sewerage companies in Manabí.*

In Figure 1, 70% of respondents stated that there is a relationship between the frequency of occupational accidents and production levels, suggesting that production demands could be creating working conditions that increase the risk of accidents. Likewise, 60% of participants stated that occupational accidents tend to occur more frequently during peak hours, which could be attributed to increased workloads, fatigue, and less attention to safety protocols in high-pressure operational contexts. Finally, with regard to training, 55% of affirmative responses indicated that lack of occupational safety training is a factor contributing to accidents, highlighting the need to strengthen occupational safety training programs to prevent such incidents. Overall, the results suggested that workplace accidents in these companies were directly related to organizational factors, such as production levels, periods of increased activity, and deficiencies in safety training. Therefore, it was recommended that priority be given to implementing preventive measures focused on these critical areas.

**Relationship between occupational accidents and production levels in technical areas**

The analysis of occupational accidents in drinking water and sewerage companies in the province of Manabí showed a direct correlation between the frequency of these incidents and production levels in technical areas. The results obtained from the survey of departmental heads of occupational safety and health reinforced this relationship, suggesting that working conditions during periods of peak demand increased the risks to which workers were exposed. As shown in Figure 1, a significant majority, corresponding to 70% of department heads, stated that occupational accidents had a direct impact on production, due to the time lost during the recovery of affected workers and the need to reschedule operational tasks. Likewise, 60% of respondents identified peak hours as critical moments, which was associated with pressure to meet production targets and the high concentration of personnel in technical areas.

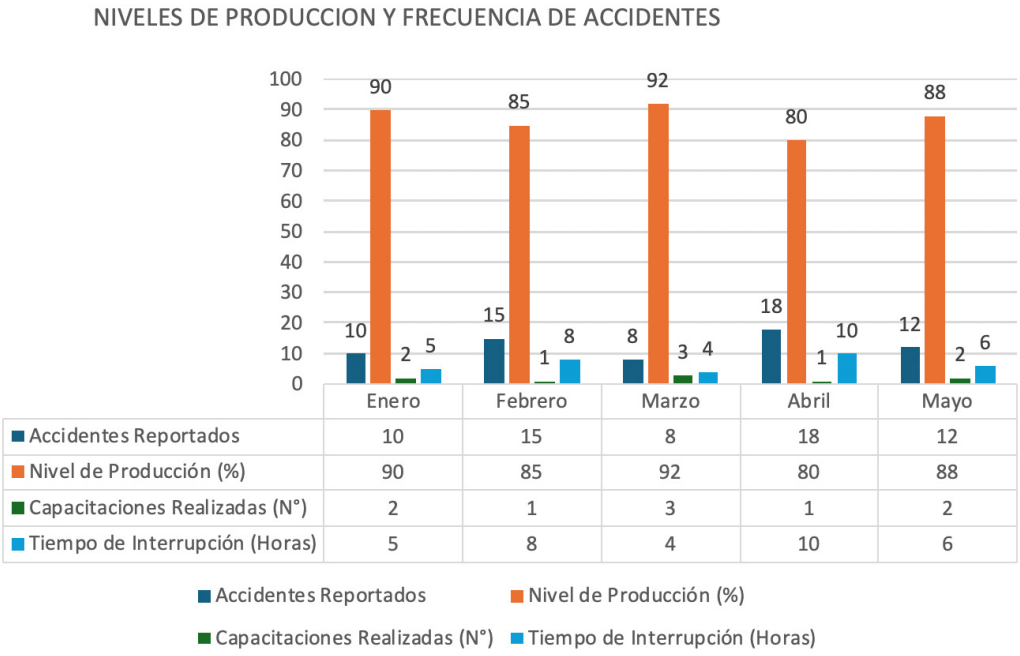
Another relevant finding was that 55% of participants pointed to a lack of occupational safety training as a determining factor in the occurrence of accidents. This result highlighted the need to implement ongoing training programs aimed at preventing occupational hazards. Similarly, 60% of respondents indicated that accidents tended to occur more frequently during periods of increased activity or “peak” periods, when the fast pace of work led to carelessness in the application of safety measures, as well as operational errors associated with fatigue and work pressure. These results suggested the importance of establishing strategies aimed at better distribution of the workload and constant supervision of compliance with safety procedures.

Finally, the lack of occupational safety training, identified by 55% of respondents, was confirmed as a key factor in the occurrence of accidents, given that the absence of specific training could lead to improper handling of equipment, failure to comply with safety protocols, and inadequate responses to risky situations. Taken together, these findings highlighted the need to strengthen preventive measures and occupational health and safety management mechanisms in the companies analyzed.

**Impact on production**

The 70% of department heads agreed that workplace accidents had a direct impact on production levels, mainly due to three key factors. First, accidents caused delays associated with the recovery time of affected workers, which limited the continuity of operational activities. Second, the need to reorganize technical tasks caused interruptions in the execution of previously planned work. Finally, accidents not only affected injured workers, but also caused distraction, demotivation, and stress among technical staff, which had a negative impact on overall performance. Likewise, an inverse relationship was observed between the frequency of occupational accidents and production levels. Companies that implemented preventive measures managed to reduce the occurrence of accidents by 15%, which was associated with a 10% increase in productivity. These results confirmed the hypothesis that occupational risks have a negative impact on production levels.

**Figure 2.**
*Production levels and frequency of accidents*

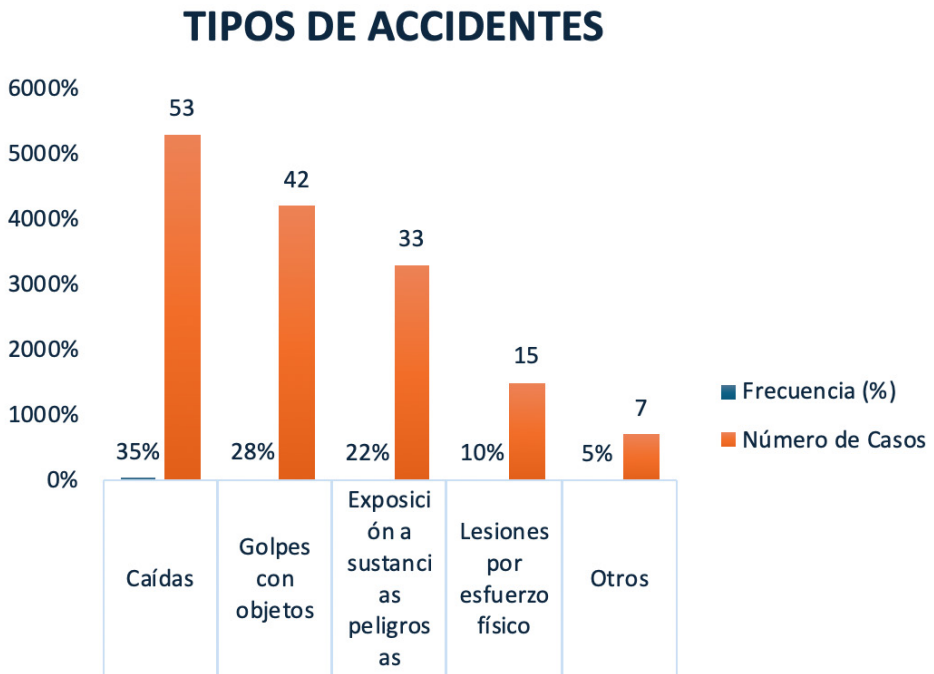



| | Enero | Febrero | Marzo | Abril | Mayo |
|---|---|---|---|---|---|
| Accidentes Reportados | 10 | 15 | 8 | 18 | 12 |
| Nivel de Producción (%) | 90 | 85 | 92 | 80 | 88 |
| Capacitaciones Realizadas (N°) | 2 | 1 | 3 | 1 | 2 |
| Tiempo de Interrupción (Horas) | 5 | 8 | 4 | 10 | 6 |

***Note:*** *The data were taken from surveys conducted with the department heads of each of the drinking water and sewerage companies in Manabí.*

It was observed that as the number of reported occupational accidents increased, production levels tended to decrease. For example, in April, when 18 accidents were recorded, the level of production fell to 80%, while in March, with only eight accidents reported, production reached 92%. These results showed that the implementation of training programs and the reduction of downtime associated with occupational accidents can have a positive impact on productivity.

**Figure 3.**
*Types of occupational accidents in drinking water and sewerage companies in Manabí*



The relationship between occupational accidents and production levels in technical areas was evident. To reduce the incidence of these events, it was necessary to adopt strategies aimed at mitigating the risks associated with workload, fatigue, and insufficient staff training. The implementation of preventive and corrective measures contributed to strengthening occupational safety and improving working conditions in the sector.

## DISCUSSION

This study analyzed a total of 150 occupational accidents that occurred in the technical area of drinking water and sewerage companies in the province of Manabí. The categorization of these incidents revealed that falls were the most frequent type of accident, accounting for 35% of the total (53 cases), followed by blows with objects (28%, 42 cases) and exposure to hazardous substances (22%, 33 cases). In addition, injuries due to physical exertion and other types of accidents accounted for 10% (15 cases) and 5% (7 cases), respectively. These findings were consistent with previous research, which indicated that the risks associated with falls, blows, and exposure to hazardous substances are recurrent in technical sectors with weak safety measures (Clanchet *et al*., 2022).

Regarding the relationship between training and occupational safety, one of the most relevant aspects identified was the existence of a significant gap in occupational safety training. Fifty-five percent of respondents attributed accidents to a lack of adequate training in safety measures, highlighting the need to implement training programs focused on risk awareness and prevention. These results coincided with studies that have shown that educational interventions and the incorporation of modern technologies, such as simulators and safety sensors, contribute effectively to reducing workplace accidents (Quezada López *et al*., 2024; Goicochea Parks *et al*., 2024). In this regard, continuous training was established as a priority, especially in companies with a higher incidence of accidents.

With regard to the impact on productivity, the results also showed that occupational accidents had a direct and significant impact on production levels. Seventy percent of department heads reported that these events caused delays due to the recovery time of the affected workers, the need to reorganize technical activities, and the psychological impact on the work team. These findings were consistent with previous research indicating that reducing accident rates not only prevents operational disruptions but also improves overall performance and lowers the costs associated with work-related accidents (Rantes & Tisnado Rivera, 2020). Complementarily, the data showed an inverse relationship between accident frequency and production levels; for example, in April, when 18 accidents were reported, production fell to 80%, while in March, with only eight accidents, a production level of 92% was achieved. This behavior underscored the importance of adopting preventive measures to ensure operational continuity.

When addressing structural and organizational challenges, the companies analyzed presented structural and organizational deficiencies, among which the absence of departments specializing in occupational safety and health stood out. This situation made them less resilient to occupational risks and highlighted the need to modernize their organizational structures. According to Lema-Jiménez *et al*. (2021), the adoption of international standards and the standardization of safety policies are essential for risk mitigation in the public sector. In this context, the importance of prioritizing institutional strengthening through the creation of specialized units that enable comprehensive occupational safety management was evident.

Finally, the analysis revealed that companies that implemented preventive measures managed to reduce occupational accidents by 15%, which was associated with a 10% increase in productivity. Among the actions implemented were the proper use of personal protective equipment, specific training, and the application of more rigorous safety protocols. In addition, technological innovations, such as the use of artificial intelligence (AI)-based tools for predictive accident analysis, were identified as strategies with high potential for improving prevention and planning in occupational safety (Tropiano & Noguera, 2024). The experience of companies that adopted these measures reinforced the importance of investing in preventive strategies as an effective mechanism for protecting workers' health while simultaneously optimizing productivity levels.

## CONCLUSIONS

Analysis of occupational accidents in drinking water and sewerage companies in the province of Manabí showed that falls (35%), blows from objects (28%), and exposure to hazardous substances (22%) were the main risks present in technical areas, followed by injuries resulting from physical exertion (10%) and other less frequent accidents (5%). These results highlighted the need to strengthen existing safety measures, particularly with regard to the proper use of personal protective equipment, the rigorous application of operating protocols, and training in the safe handling of tools, machinery, and hazardous materials. It was also concluded that the incorporation of ergonomic strategies was essential to prevent physical injuries and that attention to less visible risks, such as electric shocks, should be systematically integrated into prevention programs. In this regard, prevention and ongoing training were consolidated as fundamental pillars for reducing work-related accidents and ensuring safe working environments in the sector.

Occupational accidents were closely linked to organizational factors such as production levels, periods of peak activity, and deficiencies in occupational health and safety training. Seventy percent of respondents said that high production demands increased the risk of accidents, while 60% said that these events occurred more frequently during peak demand hours, associated with fatigue and less attention to safety protocols. Similarly, 55% identified a lack of safety training as a determining factor in the occurrence of accidents. These results confirmed the need to strengthen training processes, implement specific preventive measures during critical periods, and improve organizational management as key strategies for reducing occupational risks and protecting workers.

Finally, the implementation of integral occupational health and safety strategies proved essential both for safeguarding workers' well-being and for improving productivity levels in technical areas. Strengthening safety measures through the systematic use of personal protective equipment and the application of stricter procedures contributed significantly to reducing occupational accidents. Likewise, redistributing the workload allowed for more efficient management of pressure during times of high demand, reducing fatigue and promoting a healthier work environment. Ongoing training strengthened staff skills, increased risk awareness, and improved the ability to respond to adverse situations. Overall, the supervision and continuous monitoring of operations facilitated the timely identification and correction of risk factors, promoting a culture of prevention that not only ensured regulatory compliance but also contributed to the operational and productive sustainability of companies in the sector.

### Limitations

The study had limitations inherent to its descriptive-correlational design, which allowed associations to be identified but did not establish causal relationships between occupational accidents and production levels. Furthermore, the information was obtained from surveys administered to department heads, which could have introduced biases related to perception and self-reporting.

### Contribution to knowledge

This research generated empirical evidence on the relationship between occupational accidents and production levels in the technical area of public drinking water and sewerage companies. It also facilitated the identification of organizational factors associated with occupational accidents, providing relevant inputs to strengthen occupational safety and health management and improve productive performance.

### Statement on the use of Artificial Intelligence

AI was used exclusively for grammatical, spelling, and stylistic correction of the entire text, as well as for the translation of the title, abstract, and keywords.

### Contribución de autoría

**Valeria Stefania Cedeño Vélez:** Conceptualization, Methodology, Data acquisition, Data analysis and interpretation, Writing and Revision.

**Roberto Orlando Bello Parra:** Conceptualization, Methodology, Data acquisition, Data analysis and interpretation, Writing and Revision.

### Conflicts of interest

The authors declare that there are no conflicts of interest.

## REFERENCES


Aguilar-Pérez, P., & Cruz-Covarrubias, L. P. (2023). Análisis de la gestión de riesgos: Caso de una empresa mediana del sector comercial en Guadalajara. *UDA AKADEM, 12*, 11–37. https://doi.org/10.33324/udaakadem.vi12.669

Bryman, A. (2020). *Social research methods* (6th ed.). Oxford University Press

Célleri Pacheco, A. L., & Peñaloza Parra, P. P. (2018). *Detección del riesgo ergonómico de trastornos músculo-esqueléticos en los trabajadores de la empresa pública municipal de telecomunicaciones, y agua potable, alcantarillado y saneamiento de Cuenca 2017*. [Tesis de pregrado, Universidad de Cuenca, Ecuador] http://dspace.ucuenca.edu.ec/handle/123456789/30350

Chen, Y., & Li, S. (2020). Relationship between workplace ostracism and unsafe behaviors: The mediating effect of psychological detachment and emotional exhaustion. *Psychological Reports, 123*(2), 488–516. https://doi.org/10.1177/0033294118813892

Choudhry, R. M. (2014). Behavior-based safety on construction sites: A case study. *Accident Analysis & Prevention, 70*, 14–23. https://doi.org/10.1016/j.aap.2014.03.007

Clanchet, G. D., Pérez, E. R., García, A. M. G., & Benavides, F. G. (Eds.). (2022). *Salud laboral: conceptos y técnicas para la prevención de riesgos laborales*. Elsevier Health Sciences.

Creswell, J. W., & Creswell, J. D. (2021). *Investigación cualitativa, cuantitativa y mixta* (6.ª ed., versión en español). Pearson Educación.

Gill, J., Johnson, P., & Clark, M. (2019). *Research methods for business and management* (5th ed.). SAGE Publications.

Goicochea Parks, D. I., Manrique Nugent, M. A. L., Ogosi Auqui, J. A., & Palumbo Pinto, G. B. (2024). Nuevas tecnologías y modernización de la gestión pública perspectivas futuras. *Revista Venezolana de Gerencia (RVG), 29*(107), 1366-1381. https://doi.org/10.52080/rvgluz.29.107.25

Guerrero Aguiar, M., Medina León, A., & Nogueira, D. (2020). Procedimiento de gestión de riesgos como apoyo a la toma de decisiones. *Ingeniería Industrial, 41*(1), 1-14. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1815-59362020000100002

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage. https://eli.johogo.com/Class/CCU/SEM/_Multivariate%20Data%20Analysis_Hair.pdf

Instituto Ecuatoriano de Seguridad Social. (2021). Estadísticas de accidentes laborales registrados en la provincia de Manabí. https://sart.iess.gob.ec/SRGP/indicadores_ecuador.php#

Instituto Nacional de Seguridad y Salud en el Trabajo (INSST). (2012). *Guía para la evaluación de riesgos laborales*. Ministerio de Empleo y Seguridad Social.

Jiménez Contreras, J. C., & Figuera Ávila P. A. (2025). Evaluación comparativa en métodos de capacitación en seguridad industrial y su impacto en la reducción de accidentes laborales. *GEDI-PRAXIS, Revista de Gestión, Educación y Ciencias Sociales, 3*(2), 131-145. https://redgedi.com/opj/index.php/GEDI-PRAXIS/article/view/80

Lema-Jiménez, F. L., Quevedo-Barros, M. R., Ochoa-Crespo, J. D., & Ormaza-Andrade, J. E. (2021). Análisis de la estructura organizacional de seguridad y salud ocupacional, una revisión desde la legislación Ecuatoriana. *Dominio de las ciencias, 7*(5), 724-744. https://dialnet.unirioja.es/descarga/articulo/8383816.pdf

Ministerio de Salud Pública del Ecuador. (2022). Panorama de la salud de los trabajadores en Ecuador 2021-2022. https://www.salud.gob.ec/primer-estudio-nacional-sobre-condiciones-de-trabajo-y-salud-se-presento-en-quito/

Ministerio del Trabajo de Colombia y Organización Iberoamericana de Seguridad Social (OISS). (2013). *Informe ejecutivo de la Segunda Encuesta Nacional de Condiciones de Seguridad y Salud en el Trabajo en el Sistema General de Riesgos Laborales de Colombia*. https://www.studocu.com/co/document/pontificia-universidad-javeriana/etica-en-seguridad-y-salud-en-el-trabajo/informe-ejecutivo-ii-encsst/75513263

Occupational Safety and Health Administration (OSHA). (2023). Cuestionario sobre la seguridad y salud en el trabajo. https://www.osha.gov/sites/default/files/safety_health_programs_activities_quiz_spanish.pdf

Occupational Safety and Health Administration (OSHA). (2023). *Guidelines for safety and health programs*. Department of Labor. https://www.osha.gov

Organización Internacional del Trabajo. (2023, 26 de noviembre). Casi 3 millones de personas mueren por accidentes y enfermedades relacionadas con el trabajo. https://www.ilo.org/es/resource/news/casi-3-millones-de-personas-mueren-por-accidentes-y-enfermedades#:~:text=en%20el%20Trabajo

Quezada López, G. P., Quinde Alvear, Á. G., Manzano Merchán, F. O., & Mariño Andrade, H. G. (2024). Formación en seguridad y salud laboral: reducción de riesgos de accidentes en el sector transporte. *Conrado, 20*(97), 282-292. http://scielo.sld.cu/pdf/rc/v20n97/1990-8644-rc-20-97-282.pdf

Rantes, M. L., & Tisnado, A. B. (2020). *La seguridad y salud ocupacional en las empresas industriales y su impacto en la productividad: una revisión sistemática entre los años 2009 y 2019* [Trabajo de investigación, la Universidad Privada del Norte]. https://hdl.handle.net/11537/25845

Salcedo, C. A. (2022). *Identificación de factores de riesgos mecánicos en el personal del área de mantenimiento de la Empresa ATELEC de la ciudad de Santo Domingo* [Tesis de maestría, Pontificia Universidad Católica del Ecuador, Ecuador]. https://repositorio.puce.edu.ec/handle/123456789/38733

Saunders, M., Lewis, P., & Thornhill, A. (2023). *Research methods for business students* (8th ed.). Pearson Education. https://www.researchgate.net/publication/240218229_Research_Methods_for_Business_Students

Tropiano, Y., & Noguera, A. (2024). La inteligencia artificial en la prevención de la seguridad y salud laboral en América. *Revista Internacional y Comparada de Relaciones Laborales y Derecho del Empleo, 12*(1). https://ejcls.adapt.it/index.php/rlde_adapt/article/view/1402