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RESPIRATORY SYMPTOMS ASSOCIATED WITH CHEMICAL HAZARDS IN OPERATIONAL PERSONNEL OF THE FOOTWEAR COMPANIES AT SAN MIGUEL NEIGHBORHOOD OF CÚCUTA, NORTH OF SANTANDER

SINTOMATOLOGÍA RESPIRATORIA ASOCIADA A LOS PELIGROS QUÍMICOS EN EL PERSONAL OPERATIVO DEL SECTOR DE CALZADO EN EL BARRIO SAN MIGUEL CÚCUTA NORTE DE SANTANDER

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Respiratory symptoms associated with chemical hazards in operational personnel of the footwear companies at San Miguel neighborhood of Cúcuta, North of Santander

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ABSTRACT

Health during working life is often affected by different risk factors that cause damage to the body, such as chemical substances used in different jobs during their execution. In the footwear companies, it is very common for them to be used, so health problems for those who are continuously exposed are frequent, since workers must handle these substances on a daily basis, which leads them to inhale toxic vapors and be exposed throughout the work day, causing alterations in the airway, increasing the degree of risk due to the concentration of substances such as solvents and adhesives, exposure, and worker susceptibility, which can cause from allergic irritation to carcinogenic damage. The objective of the research was to find out the causes that generate respiratory symptoms produced by chemical substances in operational workers in the footwear companies at San Miguel neighborhood in Cúcuta, North of Santander. The study population consisted of 100 workers and, using the web-validated sample calculation method, a sample of 80 operational workers from the footwear companies at San Miguel neighborhood of Cúcuta, North of Santander was obtained. A methodology based on a mixed approach was used, which allowed investigating footwear factories to obtain detailed information on respiratory symptoms associated with chemical hazards in operational personnel. As a result, workers in the footwear companies at San Miguel neighborhood of Cúcuta, North of Santander are exposed to chemical substances that represent an unacceptable level of risk. Among the identified hazards are gases and vapors, particulate matter, and the handling of chemical liquids, each with different levels of probability and acceptability of risk according to the assessment carried out. In addition, the lack of information, training and awareness of workers to identify the danger and correct handling of chemical substances, the importance of using PPE (personal protection elements), increase the risks of suffering health problems.

Keywords: occupational disease, respiratory symptoms, chemical risk, toxic fumes, risk level

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Sintomatología Respiratoria Asociada A Los Peligros Químicos En El Personal Operativo Del Sector De Calzado En El Barrio San Miguel Cúcuta Norte de Santander

RESUMEN

La salud durante la vida laboral, en la mayoría de las veces es afectada a causa de diferentes factores de riesgos que generan daños en el organismo, es el caso de las sustancias químicas que son usadas en diferentes trabajos durante su ejecución. En el sector de calzado es muy común que se utilicen, por lo que las afecciones en la salud a quienes están expuestos continuamente son frecuentes, puesto que los trabajadores deben manipular a diario estas sustancias lo que les conlleva a inhalar vapores tóxicos y estar expuestos durante toda la jornada laboral, provocando alteraciones en la vía área, aumentando el grado de riesgo debido a la concentración de las sustancias como solventes y adhesivos, la exposición, la susceptibilidad del trabajador, lo que puede generar desde una irritación alérgica hasta una afectación cancerígena. El **objetivo** de la investigación fue conocer las causas generadoras de la sintomatología respiratoria producida por sustancias químicas en trabajadores operativos del sector de calzado del barrio San Miguel en Cúcuta, Norte de Santander La población objeto de estudio consistió en 100 trabajadores y con el método de cálculo de muestra validado en la web, se obtuvo una muestra de 80 personas trabajadores operativos del sector de calzado del barrio San Miguel en Cúcuta, Norte de Santander Se utilizó una **metodología** bajo un enfoque mixto, lo que permitió indagar en las fábricas de calzado para obtener información detallada sobre la sintomatología respiratoria asociada a los peligros químicos en el personal operativo. Dejando como r**esultado** que, los trabajadores del sector de calzado del barrio San Miguel de Cúcuta, Norte Santander, están expuestos a sustancias químicas que representan un nivel de riesgo inaceptable, entre los peligros identificados se encuentran los gases y vapores, el material particulado, y la manipulación de líquidos químicos, cada uno con diferentes niveles de probabilidad y aceptabilidad de riesgo según la evaluación realizada. Además, la poca información, capacitación y concientización de los trabajadores para identificar la peligrosidad y correcta manipulación de las sustancias químicas, la importancia del uso de los EPP (elementos de protección personal), aumentan los riesgos de sufrir afectaciones en la salud.

Palabras Clave: enfermedad laboral, sintomatología respiratoria, riesgo químico, vapores tóxicos, nivel de riesgo

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INTRODUCTION

People's health during their working life can be affected on multiple occasions by risk factors derived from exposure to chemical substances in the performance of their daily activities. In the footwear companies, workers often face this type of risk, as they constantly handle chemical products, which expose them to the inhalation of toxic vapours. This exposure can cause problems in the respiratory tract, ranging from allergic irritations to serious diseases such as cancer. The severity of the impact depends on factors such as the concentration of the chemicals, the type of substance (such as solvents and adhesives), the duration of exposure and the individual vulnerability of each worker.

In addition to respiratory problems, prolonged exposure to chemicals generates frequent absences from work, which directly affects the productivity of companies. In many cases, when absenteeism becomes recurrent, companies choose to dismiss the worker, leaving them in a vulnerable situation. This is especially aggravated in the case of those who work in informal conditions, since they do not have health insurance or occupational risk coverage that allows them to access medical treatment for illnesses related to their job.

For this reason, the main objective of this document is to analyze the causes of occupational diseases linked to exposure to chemical substances in workers in the footwear companies at San Miguel neighborhood, in Cúcuta, North of Santander This area is known for its activity in the manufacture of footwear. The study also seeks to identify the risks, both internal and external, present in footwear factories, which contribute to the development of respiratory symptoms in workers.

BACKGROUND

The footwear companies in Bangladesh stands out as an industry with great potential to strengthen the economy in an export-focused market. However, to ensure sustainable development in this area, it is essential to prioritize both the health of workers and the improvement of working conditions.

Footwear manufacturing exposes workers to a variety of risks associated with hazardous compounds, such as volatile organic compounds, hydrocarbons, toxic solvents, adhesives and polishes. Factors such as noise, high temperatures, insufficient lighting and ergonomic risks can trigger health problems such as breathing difficulties, eye irritation, asthma, body pain, hearing loss and other related symptoms.

This study surveyed more than 400 workers, including operators and supervisors, from twenty selected factories in the footwear industry in Bangladesh. The results revealed that the most common complaints among participants were recurrent headaches (41.5%), stomach aches (18.5%), eye problems (11%) and joint pains (9.5%). Cases of respiratory problems, skin irritations, coughs and hearing conditions were also identified.

In addition, the findings showed that most workers did not use personal protective equipment or have access to drinking water at their workplace. Nearly 90% of industries do not offer adequate working conditions in terms of hygiene, temperature, noise levels and lighting. These unfavourable conditions led to many employees leaving or changing jobs, mainly due to illness and the unhealthy working environment.

Direct exposure to hazardous chemicals and ergonomic risks was identified as one of the main causes of health problems reported in workers in the footwear industry. However, these negative effects could be reduced with the implementation of more advanced technologies and the replacement of hazardous chemicals with safer alternatives.

In Bangladesh, approximately 80% of the shoe factories are located in and around Dhaka, while some are located in Chittagong and Khulna. Within Dhaka, there is a high concentration of small footwear production units, with 15-50 workers per factory, in areas such as Siddique Bazaar and Bongshal. This study identified 20 selected shoe factories in Dhaka and Gazipur, designated by the letters A, B, C, through T.

Workers in these factories are exposed to various occupational hazards, including organic solvents, whose inhalation is associated with adverse effects on the lungs, increasing the risk of developing obstructive and restrictive diseases. Therefore, this study focused on investigating the relationship between exposure to these solvents, risk factors, and clinical symptoms of impaired lung function in workers in the companies.

The research used a cross-sectional approach and evaluated 134 workers, divided into two groups according to the area in which they worked: cementation (67 workers) and stock adjustment (67 workers). Pulmonary function tests were performed to measure values such as FVC and FEV1/FVC using a spirometer, in addition to interviews on clinical symptoms, health history and their work history.

The results indicated that 17% of the participants (23 of 134) suffered from restrictive diseases. The main risk factors associated with pulmonary symptoms were age, time of occupational exposure and total accumulation of exposure to chemicals. However, no significant relationship was found between exposure to organic solvents and serious lung function disorders.

For this analysis, workers with more than five years of experience in the factory and who were exposed to organic solvents such as acetone and chlorine were included, provided that their chest X-rays were normal. Those with a history of tuberculosis or other systemic diseases that may affect lung function were excluded.

The research process began by randomly selecting workers from the cementing and assembly sections of the factory. The employees from the cementing section were exposed to acetone, while those from the materials assembly section worked with acetone and chlorine. Each group consisted of 75 people, for a total of 150 participants.

All those selected underwent physical tests and spirometry. During these evaluations, 16 workers did not correctly perform the maneuvers required for spirometry and were excluded from the analysis. Likewise, in 23 participants restrictive patterns were identified in the test results, so they underwent chest X-rays, which did not show any abnormalities.

In total, 134 workers were interviewed using the Indonesian Pneumomobile Project lung function questionnaire. To measure exposure to organic solvents, specifically acetone and acetone-chlorine mixture, air monitoring was carried out in the cementing and assembly areas. Total cumulative exposure was calculated considering the working time and the recorded exposure level.

The results of the spirometry tests revealed that 23 people (17.1%) had restrictive alterations in lung function. Of these, 9 worked in the cementing section and 14 in the stock adjustment section.

Air quality monitoring showed acetone levels of 57.90 ppm in the cementing section and 64.80 ppm in the stock adjustment section, where a chlorine level of 0.001 ppm was also detected. This resulted in a combined solvent level of 0.13 ppm. All of these values remained below the permitted Biological Action Level (BAL).

Regarding the characteristics of the workers, the majority were women (59%) and 89.6% were 23.5 years old or older, with an average age of 31 years (range 23 to 50 years). In addition, more than half (55%) had

been working for the company for less than 5 years. Cumulative solvent exposure was 7.7 ppm or more in 52.2% of cases, with an average of 8.46 ppm per year (range 7.05 to 11.28 ppm).

A detailed analysis showed that symptoms of chronic bronchitis were more frequent in the stock adjustment section (62.7%) than in the cementation section (40.3%). The tables included in the study detail the relationships between factors such as age, time of work exposure, habits and symptoms with lung disorders. However, for the total population, no statistically significant relationships were found ($p > 0.05$).

Section-specific results

Stock adjustment: Working time ($p = 0.00$) and total cumulative exposure ($p = 0.00$) were factors significantly associated with pulmonary alterations.

Cementation: Age ($p = 0.056$), working time ($p = 0.00$) and total cumulative exposure ($p = 0.015$) were shown to be relevant factors.

Multivariate analysis: Variables with a p value < 0.25 were included to perform a multivariate analysis with logistic regression. This analysis revealed that:

Acetone levels were significant in both sections ($p = 0.013$).

In the stock adjustment section, cumulative exposure of 7.7 ppm or more and years of work had a significant impact ($p = 0.039$).

In the cementing section, the only significant factor was working time of 5.5 years or more ($p = 0.008$).

Related project

A research project focused on analyzing the exposure to chemicals of 15 workers from the Santina company, located in the Restrepo neighborhood in Bogotá. This company, dedicated to the manufacture of leather shoes, exposes its employees to the glue PL-285, composed mainly of toluene.

The constant use of chemicals in production activities can cause various occupational diseases. According to the Ministry of Labor (2014), among the most common problems are liver disorders, glomerulonephritis, and pulmonary hypertension. Objective of the project This degree project aimed to develop a control in the handling of chemical substances, in order to prevent and evaluate the risks that exist in the leather footwear workshop due to continuous exposure to these products. The objective is to prevent workers from suffering long-term diseases derived from this exposure. To identify the dangers, a

risk matrix was used. During the visit to the workshop, a checklist was used, photographic records were taken, and surveys were applied to the 11 exposed employees. The results indicated that workers do not recognize the chemical risks to which they are exposed, nor the possible consequences of this exposure. In addition, the company does not provide adequate personal protective equipment (PPE), nor the necessary conditions in the workplace to mitigate these risks (Joya H., Viveros R., Castro N., 2018).

At the Santina company, located in Bogotá, controls were implemented for the handling of chemical substances using a quantitative approach. This allowed the problem to be addressed in detail, in order to prevent possible negative effects on the health of workers due to the handling of these products. A survey was conducted with 10 workers in the footwear manufacturing area. The survey consisted of 30 questions related to the work environment, the use of PPE, the handling of chemical substances, the symptoms that could occur and the state of order and cleanliness in the workplace. The results showed that:

57% of workers believe that the environmental conditions in their workplace are not adequate. In addition, 61% do not know how to use personal protective equipment (PPE), since they have not been provided or trained in its use. Regarding the handling of chemical substances, 66% say that they do so safely, but only 3% have experienced symptoms related to exposure to these substances.

According to the results obtained, it is crucial to improve environmental conditions, as a poor environment could significantly increase health risks, especially when handling chemicals. However, a positive aspect is that 93% of employees believe that the conditions of order and cleanliness in the work area are good, reflecting that the organization and hygiene in general are adequate.

Another research revealed that constant exposure to organic solvents, especially in the shoe assembly area, has a negative impact on the health of workers. To address this situation, control measures have been proposed to minimize the risks related to the handling of these chemicals and thus protect the health and well-being of employees.

The objective of this study was to identify the hazards associated with the handling of chemicals, assess the qualitative exposure to these products and propose specific controls for the leather footwear company. It was a descriptive and cross-sectional study, whose methodology included direct observation of the production process in the assembly area. In addition, a survey with closed questions was applied to a

sample of 61 workers, who are part of a group of 151 people exposed to chemical solvents for more than 8 hours a day.

The results of the qualitative assessment indicated that the highest risk chemicals are Solvent C-101 and Regia PC 2000. Due to the high levels of danger they represent, it is urgent to intervene in the tasks that involve the handling of these substances. To facilitate the identification of these critical tasks, a flowchart was developed to allow a more effective intervention in the chemical risks present in the work area. According to Castilla, A.; Paredes, A. (2021) in a company, the concern to maintain control and management of the possible risks that can affect the health of its workers, raw materials and the financial part stands out. It is therefore logical that accidents and occupational diseases are causes that stop the development of company activities, which impacts production, the fulfillment of objectives and status in the market, adding to this the work, family and social impact of the worker who suffers the affectation in his health.

Job desertions among professionals are often related to accidents and illnesses such as chronic stress, muscle pain, and fatigue. These conditions cause employees to miss work, which directly impacts the company's performance and efficiency (Boada & Ficapal-Cusí, 2012). In addition, the World Health Organization points out that many companies, due to economic concerns, are reluctant to invest in an Occupational Health and Safety Management System (OHSMS), although this investment could prevent accidents and illnesses among workers.

The value of human resources and labor is fundamental for any organization, so it is vital to monitor the well-being of employees and the organizational environment. This not only protects the physical and psychological health of workers, but also the efficiency and sustainability of the company (Chan & Canul, 2018). Hence the importance of implementing an OSHMS that includes medicine, safety, and industrial hygiene actions. The objective is to understand, control and improve the health conditions of employees, ensuring a safe and healthy work environment (Molano & Arévalo, 2013).

In the case of Calzado ANYELME, according to the study carried out by Castilla and Paredes (2021), various chemicals and sharp tools are used during the footwear manufacturing process, high temperatures are handled and workers work long hours in positions that are not always ergonomic. All this makes the prevention of occupational risks a priority for the company. Therefore, it is necessary to carry out a series

of procedures, such as the planning of preventive and corrective measures, the identification of hazardous actions, risk assessment and the improvement of work areas. In addition, the health status of the worker must be known when entering the company, in order to reduce the risks that may affect their safety, thus complying with Decree 1443 of 2014.

It is essential that the investigations and design of the SG-SST focus on knowing the current conditions of the administrative and productive areas of each company. This involves identifying, evaluating and assessing the risks, which will lead to the planning of an adequate system with objectives, clear policies and the development of risk matrices for each work section. In addition, a coexistence and well-being committee must be formed to ensure compliance with the standards and regulate all aspects of the SG-SST.

The study entitled "Planning of a Safety and Health Management System at Work according to Decree 1072 of 2015 in the company Calzado ANYELME SAS, located in Cúcuta, North of Santander" used a mixed methodological approach, combining two different approaches: qualitative and quantitative.

In the context of research, it is essential to understand the basis of the studies. According to Hernández and Mendoza (2018), research studies are divided into several types: exploratory, which focus on little-studied or not yet addressed phenomena; descriptive, which seek to specify, measure, evaluate and quantify variables and phenomena within a given context; correlational, which aim to analyze the relationship between two or more variables or phenomena; and explanatory, whose purpose is to understand the causes and factors that explain the occurrence of certain phenomena in a specific context.

In the case of Calzado ANYELME SAS, an "Initial Evaluation of the Minimum Standards established in Resolution 0312 of 2019, article 16" was carried out, which was fully applied, allowing for a detailed overview of the current state of the company.

With the collaboration of the Occupational Risk Administrator SURA, compliance in matters of safety and health at work was verified. This initial assessment followed the PDCA cycle (Plan, Do, Check, Act), and the company must develop actions in accordance with current regulations, complying with each established section.

The assessment is presented in a table with scores that reflect compliance with each phase of the cycle: Plan (25 points), Do (60 points), Check (5 points) and Act (10 points), with a total of 100 possible points.

When comparing this background with the labor situation in other countries, we can see that the working conditions of workers in nations such as Bangladesh and Indonesia are much more precarious than in Colombia. In these countries, workers in shoe factories face working conditions outside the legal parameters, which seriously affects their health. In Bangladesh, 90% of industries do not have adequate conditions, and in Indonesia, prolonged working hours increase health risks due to continuous exposure to chemical substances.

In Colombia, although there are clear regulations for the prevention of occupational risks and diseases, the lack of control and supervision in their compliance causes many companies not to implement them. This endangers the health of workers, especially in the footwear companies, where they are constantly exposed to chemical substances. In addition, some companies operate informally, which leaves employees without the necessary coverage in terms of occupational risks and health, further worsening their quality of life and well-being.

In the city of Cúcuta, this situation is similar, as many companies operate informally and lack adequate surveillance by the responsible authorities. As a result, production activities are carried out without following occupational health and safety regulations. Even when companies are legal, workers are still exposed to the risks derived from the handling of chemical substances inherent to their work. This affects their health and generates absenteeism from work, and can lead to serious diseases, such as cancer, due to prolonged exposure to these substances. Years of contact with these products increase the severity of any respiratory problems that employees may develop.

METHODOLOGY

According to Tamayo and Tamayo (2012, p.37), research is defined as "a process that, through the scientific method, seeks to obtain relevant information to understand, verify, correct or apply knowledge." This process was what allowed us to develop a series of steps to obtain results that helped us meet the objectives set, and thus confirm or reject the hypothesis about the causes of occupational diseases caused by chemical agents in workers in the footwear companies at San Miguel neighborhood of Cúcuta, North of Santander

The research was designed under a mixed approach, adapting to the type of results that were sought to be obtained. Its main purpose was to identify the main causes of occupational diseases generated by chemical agents in workers in the footwear companies at San Miguel neighborhood.

According to Hernández-Sampieri and Mendoza (2008), mixed methods are a set of systematic, empirical and critical research processes that combine the collection and analysis of both quantitative and qualitative data. This approach allows the data collected to be integrated and discussed in order to make inferences that provide a better understanding of the phenomenon studied. In other words, the mixed methodology combines qualitative and quantitative approaches, using tools that allow the information obtained during the research process to be collected and interpreted.

The research design was exploratory sequential, which involved a first phase in which qualitative data was collected and analyzed, followed by a phase in which quantitative data was obtained and analyzed. In addition, the research followed a derivative modality, since the final interpretation was the result of comparing and integrating both types of data, quantitative and qualitative. According to Creswell (2009), the exploratory sequential design is appropriate when seeking to corroborate elements of an emerging theory in the qualitative phase and then systematize that information in larger samples.

The research population consisted of 100 workers from companies in the footwear companies at San Miguel neighborhood of Cúcuta, and through a validated online sample calculation method, a sample of 80 people was determined. To process the data, the Hazard Identification and Risk Assessment Matrix was used, based on the GTC-45, whose objective is to identify the hazards and assess the risks to which workers in the footwear companies are exposed at San Miguel neighborhood of Cúcuta.

RESULTS AND DISCUSSION

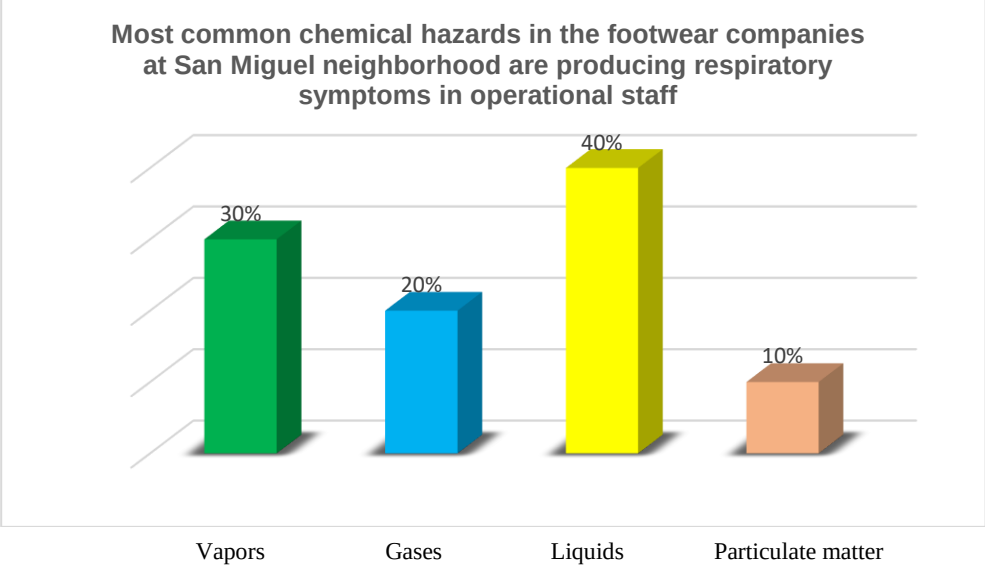
In previous studies, it was found that the chemical substances to which workers in the footwear companies are exposed are similar, regardless of where in the world they are. The type of substances, their handling and the consequences of exposure are almost identical to those experienced locally.

The analysis carried out with the GTC-45 revealed that workers in the footwear companies are exposed to chemical hazards, such as inorganic dust, particulate matter and chemical vapors. These risks are closely related to specific activities in the production of footwear, such as cutting, assembling, sewing and detailing the product.

Below are the results obtained in the data collection, where the Hazard Identification and Risk Assessment Matrix was applied, based on the GTC-45. This instrument aims to identify the hazards and assess the risks to which workers in the footwear companies are exposed at San Miguel neighborhood of Cúcuta, North of Santander

Figure 1

Most common chemical hazards found in the footwear companies - San Miguel neighborhood- Cúcuta



Source: Corredor, T, (2024) San Miguel Neighborhood, Cúcuta North of Santander

In the footwear companies at San Miguel neighborhood of Cúcuta, workers face various chemical hazards that impact their health, especially with regard to respiratory problems. Figure 1 shows the most common chemical hazards in this work environment, highlighting their prevalence and effects on workers. According to the data obtained, chemical liquids, such as solvents and adhesives (for example, Thinner and PL-285), represent the main risk to respiratory health, affecting 40% of workers. These products are used in various phases of the manufacturing process and their inhalation can cause from mild irritation to severe damage to the respiratory tract, which explains their high incidence.

Secondly, the vapors generated during the process, especially those from adhesives, constitute 30% of respiratory risks. Exposure to these vapors not only affects the lungs, but can also have long-term consequences on the neurological and gastrointestinal systems. Gases, although less frequent, represent 20% of cases of respiratory problems, mainly related to the drying and curing processes of footwear. Although their impact is less compared to liquids and vapors, they still constitute a significant risk that must be addressed.

Finally, particulate matter, such as leather fibers and wood dust, represent 10% of respiratory risks. Despite their lower incidence, this may be due to the preventive measures implemented, such as frequent cleaning of the work area and the use of masks. However, it is essential not to underestimate this danger, since constant exposure could lead to the development of chronic respiratory diseases.

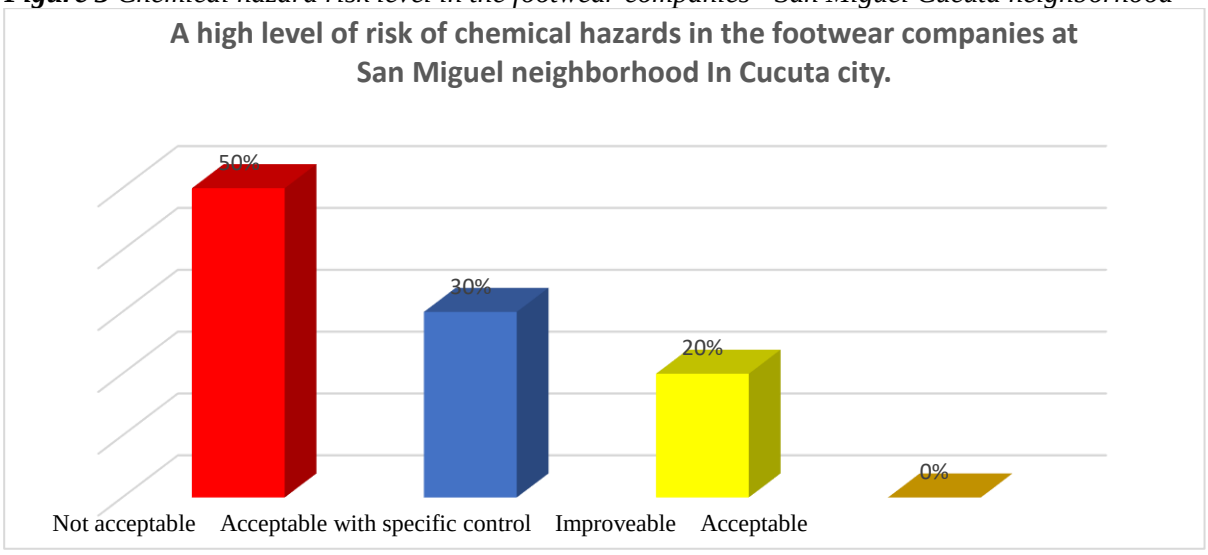
In addition, from the application of the Hazard Identification and Risk Assessment Matrix, based on the Colombian Technical Guide – GTC 45, it was possible to identify the level of risk associated with tasks involving the use of chemical substances. The results show that the danger is latent, and the classification of the risk level according to GTC 45 highlights the need to take more effective prevention measures.

Figure 2 *Risk levels as established by GTC 45.*

Risk level	Risk level value	Meaning
I	4000-600	Not acceptable (Very high and/or critical risk)
II	500-150	Acceptable with specific control (High risk)
III	120-40	Improveable (Medium risk)
IV	20	Acceptable (Low risk)

Source: Colombian Institute of Technical Standards and Certification (ICONTEC). (2012). GTC 45.

Figure 3 *Chemical hazard risk level in the footwear companies - San Miguel Cúcuta neighborhood*



Source: Contreras, S. and Prieto, L. (2024). San Miguel Neighborhood, Cúcuta, North of Santander

According to the figure above, it can be seen that some tasks present a risk level I, classified as Not Acceptable (very high), which requires immediate intervention. These activities include finishing processes, such as the application of paint with products such as toluene and benzene. The danger identified in these cases is the inhalation of solvents, which are liquid substances that release toxic vapors into the environment, and constant exposure to these vapors considerably increases the risk to workers' health.

Another critical process is the assembly of components, where liquid adhesives are used. In this case, the vapors of solvents and sealants generated by continuous exposure also represent a significant danger to employees, who are forced to work in an environment loaded with these compounds.

In the case of chemical risks with level II, classified as acceptable with specific control, there are activities such as the production by cutting of materials, such as leather and synthetic materials. These processes generate exposure to fibers released from materials, which is harmful to the respiratory tract and mucous membranes. Although the risk level is lower, it remains a major concern for the health of workers.

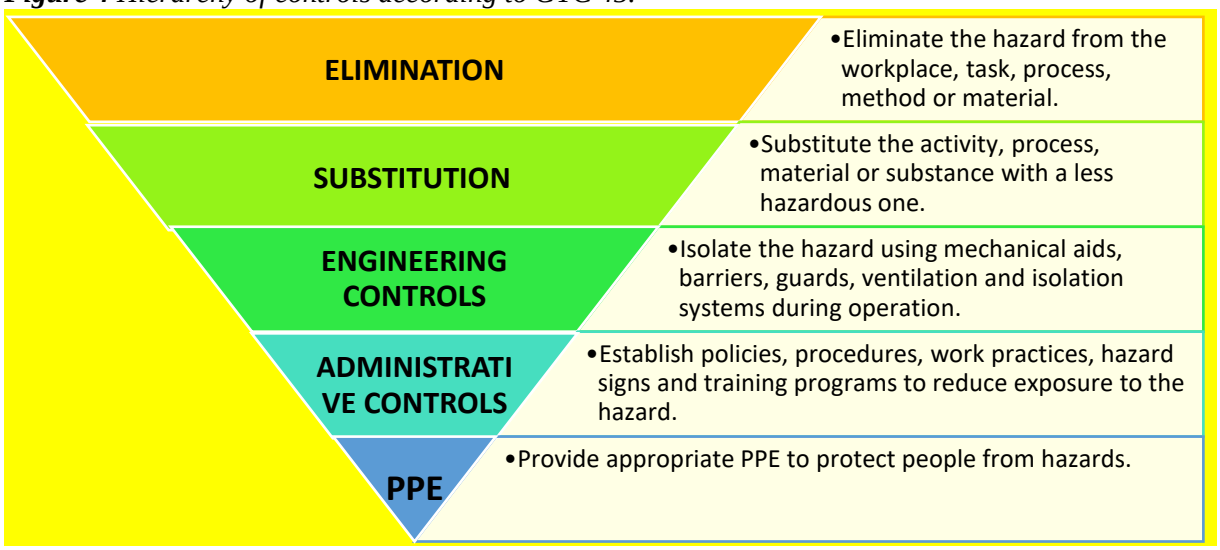
Finally, at level III (medium risk), corrosive liquids such as acetic acid and hydrochloric acid are identified, which can be spilled during the handling and storage of chemicals in the warehouse area. Occasional exposure to these products presents a moderate risk, but is considered to be improvable. However, the conditions in which employees work, such as the lack of adequate protective clothing, aggravate the situation, since there is not enough to minimize contact with these substances.

What is alarming about this situation is that no chemical hazards with low risk are identified in the footwear companies at San Miguel neighborhood, which highlights the lack of effective controls or the absence of them. In addition, the frequent use of chemical substances in large quantities and prolonged exposure to them seriously compromise the health of workers, especially the respiratory system. The lack of personal protective equipment and the poor regulation in the footwear company further aggravate this situation.

Based on the identification of the risk levels of chemical hazards and the analysis of the exposure of workers in the footwear companies at San Miguel neighborhood, specific intervention measures are

proposed, adapted to the risk levels detected, to improve working conditions and safety in tasks involving the use of chemical substances.

Figure 4 *Hierarchy of controls according to GTC 45.*



Source: Colombian Institute of Technical Standards and Certification (ICONTEC). (2012). Colombian Technical Guide – GTC 45.

With regard to the different processes that are carried out in the performance of tasks by operational workers in the footwear companies at San Miguel neighborhood of the city of Cúcuta, it has been identified that there are dangers with an unacceptable level of risk, for which immediate intervention measures are established to minimize these risks, so that workers can continue to carry out the different activities of the footwear manufacturing processes in a safe manner. These measures not only help workers to have more confidence in carrying out their tasks, but also help the employer to reduce costs in terms of work accidents that may occur and legal problems.

Once the hazards have been identified and the risks assessed, the first measure to be implemented is the design and implementation of the Occupational Health and Safety Management System (OHSMS). This system will allow activities to be carried out safely and in stages, with a constant focus on continuous improvement. In this way, the employer will be able to better plan tasks, anticipate risks, recognize them, assess them and control them effectively. Applying this system not only contributes to a safer work environment, but also improves the general working conditions, guaranteeing the physical, mental and social well-being of employees.

It is essential to take into account Decree 1072 of 2015, which is one of the key sources of rules and regulations for the labour companies in Colombia. This decree must be consulted regularly in all work activities to ensure that safety standards are met.

In order for workers to be able to perform their duties safely, it is essential that the employer provides appropriate personal protective equipment (PPE). These devices act as a physical barrier against the risks present in the work environment, protecting the health of workers. In addition, the employer has the responsibility of training employees on the correct use of these protective elements so that they can use them effectively during their work day.

In the footwear sector, workers are exposed to various chemical substances that can have different effects on their health and the work environment. Therefore, it is crucial that the employer is trained in the application of the Globally Harmonized System (GHS). This system provides detailed information on the properties of chemical products, their classification and labeling according to their dangerousness. The use of the GHS is mandatory in all work sectors where chemical substances are handled. In addition, these substances must be stored safely, in their original containers, and classified according to their compatibility with other products. It is necessary to label them appropriately according to international standards and take into account that environmental conditions, such as heat, light and humidity, can affect their stability, which makes it essential to maintain adequate control to avoid accidents. Spill control materials such as containment barriers, gloves, waste bags, safety glasses and, where appropriate, protective suits must also be available.

Another key measure is to improve the infrastructure, especially ventilation in the work areas where footwear is manufactured. Good airflow is crucial to minimize the concentration of gases, vapors and particulate matter that can put workers' health at risk.

In addition, it is advisable to establish staff rotation schedules to distribute tasks in a balanced manner and reduce exposure times to risks. Active breaks are also essential, as they help improve the physical well-being of employees and optimize their work performance.

Finally, workers have a number of responsibilities to ensure safety in the workplace. They must report any unsafe acts or conditions they observe, actively attend training, comply with safety regulations, follow established procedures and correctly use the personal protective equipment provided.

CONCLUSIONS

Based on the analysis and previous discussions, it was concluded that:

• Footwear companies' workers are exposed to chemical hazards, given that, in the execution of their daily tasks, the frequent use of chemical substances, mainly adhesives, solvents, hydrocarbons, cause health problems, from mild impacts to chronic occupational diseases that lead to death.

• The identified hazards allow us to see the importance of implementing controls in the management of these chemical substances; to mitigate the impact they cause on the health of workers.

• The Risk Assessment allowed us to verify that exposure to chemical liquids, such as solvents and adhesives, present one of the highest risks in this work environment.

• The implementation of effective controls is essential, not only the use of personal protective equipment (PPE) by workers, but also the improvement of workplace conditions

• Likewise, it is essential that continuous and specific training is carried out for workers, aimed at identifying hazards, safe handling of chemical substances, and adequate response in emergency situations.

• It is important to highlight that the protection of workers in the footwear companies is not only a legal and ethical obligation, but is also an investment in the sustainability and productivity of companies.

• A safe and healthy work environment contributes to the reduction of absences due to illness, improves worker morale, and increases operational efficiency. Therefore, companies must see safety and health at work as a strategic priority that can have a positive impact on both their results and the well-being of their workforce.

• It is important that inspections are carried out by the entities in charge of compliance with the safety and health at work regulations that regulate the operation of the activities of this productive sector.

• It can also be concluded that not only the employer must comply with the different security measures, but the worker also has the responsibility to comply with the different rules and strategies established so that the processes are carried out in an effective and safe manner, allowing them to minimize the risks.

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