

Exposure of workers in tanneries, construction and beauty salons in Armenia to occupational environmental pollution. Case study

Exposición de los trabajadores de curtiembres, obras de construcción y salones de belleza de Armenia a contaminación ambiental laboral. Caso de estudio

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ABSTRACT

The objective of this research was to evaluate the working and health conditions of workers in three sectors of the economy of Armenia, Colombia (tanneries, construction sites, and beauty salons) exposed to chemical and physical agents. A descriptive observational study of the working conditions and health of workers in their work environments was carried out, by visiting 10 companies per sector. The evaluation of working conditions in construction sites gave High (high risk), as well as in tanneries. Beauty salons gave an evaluation of Medium (medium risk).

Keywords: Tanneries; Construction sites; Beauty salons; Exposure; Safety and occupational health.

RESUMEN

El objetivo de esta investigación fue evaluar las condiciones de trabajo y salud de los trabajadores, de tres sectores de la economía de Armenia, Colombia (curtiembres, obras de construcción y

salones de belleza), expuestos a agentes químicos y físicos. Se realizó un estudio observacional descriptivo de las condiciones de trabajo y salud de los trabajadores en sus entornos laborales, visitando 10 empresas por sector. La evaluación de las condiciones de trabajo en las obras de construcción dio un resultado Alto (riesgo elevado), al igual que en las curtiembres. Los salones de belleza obtuvieron una evaluación Media (riesgo medio).

Palabras clave: Curtiembres; Salones de belleza; Construcción; Exposición; Seguridad y salud en el trabajo.

INTRODUCTION

Breathing quality indoor air is critical for good health because people spend a large amount of time indoors. In works related to the measurement of indoor air quality, the focus has been on determining the environmental conditions and chemical compounds in the air in the spaces where people live. To assess the risk of indoor air pollution, the four elements of any risk assessment must be considered (Qiu *et al.* 2019; Carazo Fernández *et al.* 2013;

Cremades, 2006): risk identification, dose-response assessment, exposure assessment, and risk characterization.

For leather production, chemical tanning uses primarily mineral salts such as chromium sulfate, and alternatively fish oils or synthetic tannins. Some factories have highly mechanized systems and use closed automatic systems and many chemicals. Among the chemical agents, the wide variety of acids, alkalis, tannins, solvents, disinfectants, chromium, and bleaching agents, among others, can be irritating to the respiratory tract and skin. In Colombia, numerous industries handle Cr compounds, including tanneries. Official data report approximately 800 tanneries in operation, of which 60 % are located in Bogotá (Cuberos *et al.* 2009). Exposure to Cr⁶⁺ as a predominantly occupational risk is considered a Group I carcinogen by the International Agency for Research on Cancer (IARC, 1995). But, Cr³⁺ used in the tannery industry in the form of chromium salts has not been proven to be carcinogenic (González Fernández, 1992; Cohen *et al.* 1993; Cuberos *et al.* 2009; Rangel Cordova *et al.* 2015; Alibardi & Cossu, 2016). As for physical agents, noise can represent a problem in many of the machines used, especially in drums and routers, because they generate sound pressure levels above 85 dB(A) (United States Department of Labor, 2022).

On the other hand, on construction sites, workers are exposed to a wide variety of health hazards. Exposure varies from job site to job site; exposure to any hazard is usually intermittent and of short duration, but is likely to recur. A worker may not only encounter the primary hazards of his or her work but may also be exposed as a passive observer to hazards generated by those working in his or her vicinity. This pattern of exposure is one of the consequences of having many jobs of relatively short duration and working alongside workers in other risk-generating jobs. The severity of each risk depends on the concentration and duration of exposure for a given job. As in other jobs, the risks for construction workers are usually chemical (paints, varnishes, particulate matter) and physical (noise from drills, machinery, welding, etc.). Then, pollutants can come from: noise pollution, solid and liquid waste, water pollution, harmful gases, and dust (Enshassi *et al.* 2014).

In the case of hairdressing salons, many associated hazards can pose a risk to both the safety and health of customers and workers, such as physical, chemical, mechanical, and biomechanical hazards, the latter having the greatest impact. Contact with products containing hazardous chemicals poses a significant risk, since they cause injuries or conditions by inhalation, skin contact, or accidental ingestion (dyes, solvents, enamels), in addition to the noise of the dryers (Caraballo-Arias *et al.* 2013; Lozano Ramírez & Montero Martínez, 2015; Baghania *et al.* 2018).

One of the aims pursued by the Colombian legislation on occupational safety and health is to improve working conditions; for this, not only must there be the resources, methods, and/or techniques to identify what these working conditions are, but it must also be possible to assess their degree of adequacy: from identifying very unfavorable situations that have to be urgently

modified, to situations where working conditions, in principle, are adequate (Mintrabajo, 2015).

In Armenia, there are approximately 18 tanneries, 120 construction sites, and 250 beauty salons. The predominant pathologies in workers in these sectors due to uncontrolled exposure to chemical agents are (Cremades, 2006; Chandra Kashyapa *et al.* 2021): contact dermatitis, rhinitis and conjunctivitis, bronchial asthma and irritative respiratory diseases.

Therefore, the objective of this research was to evaluate the working and health conditions of workers in three sectors of the economy of Armenia (tanneries, construction sites, and beauty salons) exposed to atmospheric pollutants, as well as other chemical and physical agents.

MATERIALS AND METHODS

A descriptive observational study of the working conditions and health of workers in the work environments of tanneries, construction sites, and beauty salons was carried out. Due to budgetary limitations, convenience sampling was chosen, in this case, 10 companies per sector. Of these companies, 10 % of the workers in construction sites and tanneries and 50 % in beauty salons were studied.

The study included reconnaissance visits through a structured guide and field diary, sampling of basic hygiene measurements of exposure to atmospheric pollution (noise, lighting, and particulate matter), and surveys of working and health conditions.

For environmental sampling, some equipment and instruments were used (sound level meters, personal sampling pumps, dosimeters, with their respective calibrators). The analytical methods followed the American Conference of Governmental Industrial Hygienists' international standards (ACGIH, 2021). For the illumination level, an Extech Instruments HD 450 luxmeter, certificate LX-13016865-7963, was used. For noise, a 3M sound level meter model SD-200 Class 2 Integrating SLM, certificate 288082SD20013144, +/-2.2% acoustic (0.19 dB). For the total dust sample, a GilAir Plus Gilian Assembly, STP, P/N 610-0901-03-R personal air sampling pump. The filters used were silical 5.0 µm PH-PVC 37 mm. A silica gel desiccator and a Precisa 405M-200^a analytical balance were also used. The analytical method used was the NIOSH standard 500 "Total non-respirable dust" (NIOSH, 1994).

The sampling of particulate matter in the construction sector lasted a 9-hour working day. The sampling time was 60 minutes at a flow rate of 1.7 L min⁻¹.

To define the working conditions, the atmospheric pollutants to which workers are exposed were identified, located, and assessed, using national and international standardized analytical methods from the National Institute for Occupational Safety & Health (NIOSH) 0500 and ACGIH (ICONTEC, 1995; 1997a; 1997b; ISO, 2018; ACGIH, 2021). In addition, a self-reporting tool of health conditions was used, which allows knowing the

morbimortality and absenteeism due to occupational events generated by exposure to air pollutants.

RESULTS AND DISCUSSION

In the workspace discomfort surveys, problem areas were found to be the passageways and the facilities themselves. As can be seen in figure 1, 24 % of the construction workers expressed discomfort with the transit zones and 14.3 % with the facilities. This is because the spaces are obstructed by materials, impeding pedestrian areas. There was little evidence of this in beauty salons. In tanneries, 30 % do not have adequate transit zones.

In terms of exposure to physical agents, workers reported discomfort

from noise (hairdressers from the hairdryers and workers from the polishing machines). However, in the tanneries, noise does not exceed the maximum permissible limit of 85 dB. Construction workers complained about the ambient heat and warehouse workers about the poor lighting.

The workers coincided with the presence of discomfort due to exposure to chemical agents. In construction, 57 % of the workers reported discomfort from particulate material, which is not a single pollutant, but rather is a mixture of many chemical species. In beauty salons, 47 % of the stylists reported discomfort from the use of chemical products. In tanneries, 48 % of the workers also reported discomfort from the chemicals used in the leather process. Stylists and tannery workers also coincided with the discomfort

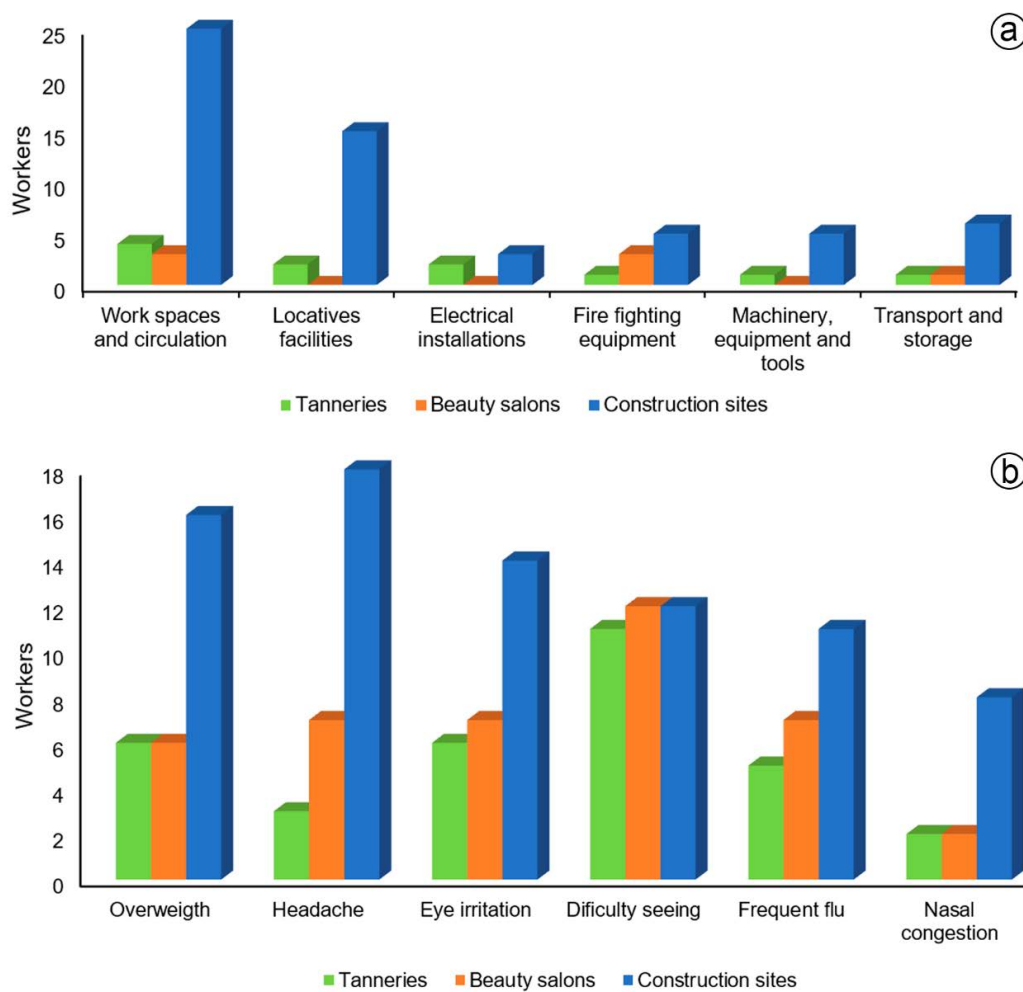


Figure 1. Working and health conditions in the tanneries, beauty salons and constructions sites visited, according to the discomfort surveys. a) Poor security conditions; b) Healthy conditions.

caused by the gases and vapors given off by the chemical products when handling them.

As for poor ergonomic conditions, 54.2 % of the construction workers and 40 % of the workers in beauty salons agreed that they had discomfort due to long hours of work with postural strain,

especially those in construction, who have to work against the clock on construction sites. Only in a high season do stylists work more than 12 hours a day.

Regarding organizational conditions, construction site workers and tannery workers expressed dissatisfaction with the provision of

restrooms. They also reported deficiencies in economic incentives and long working hours.

As shown in figure 1, approximately, 15 % of the workers surveyed suffer from being overweight, and 20 % from headaches. It can also be seen that they have difficulty seeing up close or far away. On the other hand, it can be seen that both construction and tannery workers suffer from physical exhaustion or fatigue, as well as fatigue when getting up.

According to the sociodemographic study of the workers surveyed, the predominant gender in the construction and tannery sectors is male, while in the beauty salon sector it is predominantly female. The predominant ages in these sectors are between 21 and 40 years old, which is equivalent to more than 51 % of the working population. As for the predominant positions in the companies visited, in the tanneries, 72 % are miscellaneous jobs. In the beauty salons, stylists account for 71.8 %. In construction, the position of assistant represents 50.4 %, followed by miscellaneous jobs with 29.5 %.

In terms of experience in construction sites, 90 % of the workers have up to one year, 31.2 % of the stylists have between 10 and 20 years and in tanneries, they have about 5 years of work. 52.3 % of construction workers have a high school education, as well as 31.2 % of stylists and 40 % of tanners. But, only 10 % of them completed secondary school. In the beauty salon sector, the main choice was for technical beauty studies. Of the 162 workers surveyed, 17.3 % reported other studies, with a preference for image consulting and

English. In addition, 44 % of the workers practice some type of sport or art (soccer, cycling, skating, dancing, painting, weaving).

The evaluation of working conditions in construction sites gave **High**, as well as in tanneries. Beauty salons gave an evaluation of **Medium** due to the handling of chemical products and exposure to physical agents.

The basic hygienic conditions of the analyzed posts (general areas, leather finishing, painting, and ironing; manicurist, stylist; warehouse, welding, and assembly of beams and windows) were:

Lighting: the overall average lighting (Table 1) shows how in construction sites, administrative and warehouse facilities are temporary, and lighting conditions are not adequate, as they are below the recommended value.

Noise: The result for the tanneries is **73 dB(A)**, which does not exceed the noise Threshold Limit Value (TLV) of 85 dB(A) (MinTrabajo & MPSPS, 1990). It should be noted that all the tanneries visited have very controlled noise levels. For the beauty salons, the noise level is **79 dB(A)** in the use of hair dryers, which does not exceed the noise TLV. In construction sites, the polisher produces a noise of **91.8 dB(A)** with the circular saw without cutting and **99 dB(A)** with cutting, working an average of 4 hours a day. All exceed 85 dB(A) daily and the risk level is **7.01**, indicating a high noise risk. The use of adequate hearing protection was not detected (Londoño Ciro, 1996).

Table 1. Lighting levels in indoor conditions in three sectors of the economy of Armenia, Colombia.

Activity	Recommended level (lux)	Measured level (lux)
Tanneries	500-750-1000	488
Beauty salons	500-750-1000	856
Construction sites	200-300-500	
Administration and warehouse		193.3
Welding		67.5 – 214.5
Pipe installation		55.05

In the construction sector, the theoretical TLV for lime and cement is 10 mg m³. The concentration measured was **20.6 mg m³**. The degree of risk is **2.058** (Very high). The personal protection element used by the workers is a common disposable mask, not effective for high dust concentrations.

At the construction sites, safety measures for high-risk tasks are deficient. Concerning individual protection, inadequate use of personal protective equipment was observed; helmet-type hearing protectors are used incorrectly, in addition to eye protection.

All tanneries have managed to minimize noise, which does not exceed 80 dB(A), but as for respiratory protection, they use an inadequate element for protection against gases and vapors.

In the esthetics sector, the beauty salons, in compliance with local safety requirements, have controlled noise and the asepsis of the utensils. It was observed that 30 % of the salons adequately use personal protective equipment for handling dyes and colorants.

Conflicts de interest: The manuscript was prepared and reviewed with the participation of all the authors, who declare that there

is no conflict of interest that could jeopardize the validity of the results presented.

REFERENCES

- ALIBARDI, L.; COSSU, R. 2016. Pre-treatment of tannery sludge for sustainable landfilling. *Waste Management*. 52:202-211. <https://doi.org/10.1016/j.wasman.2016.04.008>
- AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS, ACGIH. 2021. TLVs and BEIs: Threshold limit values for chemical substances and physical agent: Biological Exposure Indices. ACGIH. 190p.
- BAGHANIA, A.N.; ROSTAMI, R.; ARFAEINIA, H.; HAZRATI, S.; FAZLZADEH, M.; DELIKHOON, M. 2018. BTEX in indoor air of beauty salons: Risk assessment, levels and factors influencing their concentrations. *Ecotoxicology and Environmental Safety*. 159:102-108. <https://doi.org/10.1016/j.ecoenv.2018.04.044>
- CARABALLO-ARIAS, Y.; RODRÍGUEZ, A.R.; RIVERO, Á.J.; RANGEL, R.G.; BARRIOS COVARO, M. 2013. Riesgos laborales en trabajadores de barberías y peluquerías de economía informal. *Caracas, Venezuela. Ciencia & trabajo*. 15(46):18-23. <http://dx.doi.org/10.4067/S0718-24492013000100005>
- CARAZO FERNÁNDEZ, L.; FERNÁNDEZ ALVAREZ, R.; GONZÁLEZ-BARCALA, F.J.; RODRÍGUEZ PORTAL, J.A. 2013. Contaminación del aire interior y su impacto en la patología respiratoria. *Archivos de Bronconeumología*. 49(1):22-27. <https://doi.org/10.1016/j.arbres.2012.04.005>
- CHANDRA KASHYAPA, G.; KUMAR SHARMAB, S.; KANT SINGHB, S. 2021. Prevalence and predictors of asthma, tuberculosis and chronic bronchitis among male tannery workers: A study of Kanpur City, India. *Clinical Epidemiology and Global Health*. 9:71-77. <https://doi.org/10.1016/j.cegh.2020.07.002>
- COHEN, M.D.; KARGACIN, B.; KLEIN, C.B.; COSTA, M. 1993. Mechanisms of Chromium carcinogenicity and toxicity. *Critical Reviews in Toxicology*. 23(3):255-281. <https://doi.org/10.3109/10408449309105012>
- CREMADES, L. 2006. Contaminación química de aire en espacios interiores, UPC PLUS. BCN. 76p.
- CUBEROS, E.; RODRÍGUEZ, A.I.; PRIETO-SUÁREZ, E. 2009. Niveles de cromo y alteraciones de salud en una población expuesta a las actividades de curtiembres en Bogotá, Colombia. *Revista de Salud Pública*. 11(2):278-289.
- ENSHASSI, A.; KOCHENDOERFER, B.; RIZQ, E. 2014. An evaluation of environmental impacts of construction projects. *Revista ingeniería de construcción*. 29(3):234-254. <http://dx.doi.org/10.4067/S0718-50732014000300002>
- GONZÁLEZ FERNÁNDEZ, E. 1992. Toxicocinética y evaluación de riesgos para la salud producidos por la exposición a los compuestos de cromo. *Medicina y Seguridad en el Trabajo*. 38:3-27.
- INSTITUTO COLOMBIANO DE NORMAS TÉCNICAS Y CERTIFICACIÓN, ICONTEC. 1995. NTC 3701. Higiene y Seguridad. Guía para la clasificación, registro y estadística de accidentes del trabajo y enfermedades profesionales. ICONTEC. 31p.
- INSTITUTO COLOMBIANO DE NORMAS TÉCNICAS Y CERTIFICACIÓN, ICONTEC. 1997a. NTC 4116 Seguridad Industrial. Metodología para el análisis de tareas. ICONTEC. 19p.
- INSTITUTO COLOMBIANO DE NORMAS TÉCNICAS Y CERTIFICACIÓN, ICONTEC. 1997b. NTC 4114 Seguridad Industrial. Realización de Inspecciones Planeadas. ICONTEC. 10p.
- INTERNATIONAL AGENCY FOR RESEARCH ON CANCER, IARC. 1995. IARC monographs on the evaluation of carcinogenic risks to humans. Vol.62. Lyon (France). 423p.
- LONDOÑO CIRO, J. 1996. Higiene III. Factores de riesgo químico. Universidad del Quindío. 24p.
- LOZANO RAMÍREZ, T.; MONTERO MARTÍNEZ, R. 2015. Análisis de los riesgos ocupacionales que se originan en peluquerías y lugares de estéticas: proposiciones para su control. *El Hombre y la Máquina*. 46:59-71.
- MINISTERIO DE TRABAJO, MINTRABAJO. 2015. Decreto 1072 de 2015. Por medio del cual se expide el Decreto Único Reglamentario del Sector Trabajo. MinTrabajo. 326p. Disponible desde internet en: <https://www.mintrabajo.gov.co/documents/20147/0/DUR+Sector+Trabajo+Actualizado+a+15+de+abril++de+2016.pd/f/a32b1dcf-7a4e-8a37-ac16-c121928719c8> (con acceso el 21/04/2021).
- MINISTERIO DEL TRABAJO, MINTRABAJO; MINISTERIO DE SALUD Y PROTECCIÓN SOCIAL, MPSPS. 1990. Resolución 1792 DE 1990. Por la cual se adoptan valores límites permisibles para la exposición ocupacional al ruido. 2p.
- NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH, NIOSH. 1994. Particulates not otherwise regulated, total: Method 0500. Fourth edition. NIOSH

- Manual of Analytical Methods NMAM. 3p.
21. ORGANIZACIÓN INTERNACIONAL DE NORMALIZACIÓN, ISO. 2018. ISO 45001 Sistemas de gestión de la seguridad y salud en el trabajo - requisitos con orientación para su uso. ISO (Suiza). 60p. Disponible desde internet en: <https://www.unidadvictimas.gov.co/sites/default/files/documentosbiblioteca/iso-45001-norma-internacional.pdf> (con acceso el 14/01/2021).
 22. QIU, Y.; YANG, F.-A.; LAI, W. 2019. The impact of indoor air pollution on health outcomes and cognitive abilities: empirical evidence from China. *Population and Environment*. 40:388-410.
<https://doi.org/10.1007/s11111-019-00317-6>
 23. RANGEL CORDOVA, A.A.; ISARAIN CHÁVEZ, E.; MALDONADO VEGA, M. 2015. Caracterización y recuperación de sales de cromo hexavalente de un pasivo ambiental. *Revista internacional de contaminación ambiental*. 31(4):427-437.
 24. UNITED STATES DEPARTMENT OF LABOR. 2022. Occupational Noise Exposure. Disponible desde Internet en: <https://www.osha.gov/noise>