An Analysis of the use of Individual Protective Equipment by Workers in the Metallurgical Production Sector

Patrícia Pereira Araújo Gomes[1], Zarur de Oliveira Silvano[2], Josiane Aparecida Cardoso de Souza[3]
[1]*Student of Industrial Engineering, Faculdades Integradas de Cataguases-FIC/UNIS*
[2]*Specialization in Business Management,,Faculdades Integrada de Cataguases , Cataguases/MG, Brazil*
[3]*MBA in Industrial Enginnering, Universidade Federal de Minas Gerais, Belo Horizonte/MG, Brazil*

Abstract

Safety at work is becoming increasingly important within organizations. The present article looked for current information about the accidents occurred in a metallurgical company, aiming to identify the risks that caused these accidents in the productive sector, indicating the number of accidents and the safety procedures performed by the company. It is a research carried out in a company in Minas Gerais, where non-participatory observation and a questionnaire were used as a data collection instrument, also the noise levels which workers were submitted in the production sector of the metallurgist. The company does not provide adequate personal protective equipment for the functions performed and does not have training on the correct use and importance of safety equipment for the prevention of occupational accidents. As an improvement it is suggested to provide adequate personal protective equipment for the need of each function, training for correct use and awareness of the importance of accident prevention and to carry out inspections to verify the use.

Keywords - *Accidents, Workplace Safety, Noise, Metallurgical.*

I. INTRODUCTION

According to [1] The negligence of the employer with his employee results in the so-called work accident. According to [2], in the prevention of work accidents employers have a fundamental duty; they must take preventive measures, give importance to the professional, safety, health and ensure that employees have the necessary supervision, information and training exercise the job safely. [3] says that employees need to make sure about accidents and commit their job safety related duties in the exercise of the function and to be conscious. Reference [4] shows that personal protective equipment (PPE) plays an important role in the safety and health of the employees and, when used in the workplace, reduces exposure to a variety of risks. According to reference [5] the use of PPE usually presupposes working in a possibly hazardous workplace. [4] notes that personal protective equipment includes items such as helmets, gloves, boots, overalls, goggles and ear protectors.

According to [6], PPE, especially ear protectors, is essential when there is a risk of physical noise, indicating that the work activity is unhealthy, or even when the work area indicates high sound pressure levels or noise, beyond the tolerance limits determined by the national legislation.

According to data from [7], the total number of accidents at work by sector of economic activity in 2011/2013 and the number of accidents recorded in the metallurgical sector was 10,625 in 2011, 10,300 in 2012, and 10,439 in 2013.

The general objective of the work, carried out in a small metallurgical company located in Minas Gerais, Brazil, which produces stainless steel and galvanized sheet's letters, numbers and logos – Data collected by the questionnaire applied is to identify the risks of accidents at work and the noises that employees are exposed, non-participatory observation and noise measurement with the dosimeter, with a work safety technique and through Minitab software version 17.1.0. The specific objectives were to calculate the values that were generated minute by minute in the dosimeter; to check what procedures should be taken in order for employees to have their physical health preserved as well as greater well-being and safety in the work environment.

II. METHODOLOGY

A. Ranking

The present study was characterized as a descriptive research, of an exploratory nature, with both qualitative and quantitative approaches and the documentation technique was directly intensive.

According to [8], it is descriptive when the observer only describes and exposes events without interfering. This study aims to describe the work-related problems, such as noise and the PPE needed to perform the task according to NR 6 and NR15.

It has an exploratory character, since the present study has a bibliographical methodology. [9] bibliographical citation for the theoretical and methodological basis of the work where books,

articles, theses and dissertations on the subject were used.

With qualitative-quantitative characteristics, considering everything that can be calculated and specified.

"Unlike the qualitative research, the results of quantitative research can be quantified. As the samples are generally large and considered representative of the population, the results are taken as if they constituted a real picture of the entire population targeted by the research. Quantitative research focuses on objectivity. Influenced by positivism, it believes that reality can only be understood based on the analysis of raw data, collected with the aid of standardized and neutral instruments. Quantitative research uses mathematical language to describe the causes of a phenomenon, the relationships between variables, and so on. The combined use of qualitative and quantitative research allows us to gather more information than could be achieved in isolation. "[10]

It is considered directly intensified when it is produced in the field, because according to [11] it is an information collected at the place where the research was carried out. In order to do so, technical visits were made to the establishment to follow the manufacture of the signs, to apply the questionnaire and analyze the workplace where the workers are exposed to risks. In addition to ascertain if the responses of the employees coincide with the reality of the company. In this way, the study intends to identify the risks of work accidents to which they are exposed and ways of protecting employees using the PPE correctly.

In order to study and analyze the data collected, Minitab version 17.1.0 was used, which according to [12] is a statistical software that accepts descriptive statistics, distributions and simulations, regression, variance analysis, elementary statistical inference, categorical data, time-series analysis, non-parametric methods, etc. In addition, noise control graphs were produced in the work environment in order to analyze the noise level that the employees are submitted daily in their work environment.

B. Company Characterization

This study was carried out in a medium-sized metallurgical company, with more than 38 years of experience, located in the city of Cataguases / Minas Gerais. Its function is the manufacture of numbers, logos and signs, using galvanized sheet and stainless steel as the main raw material.

The company studied has a staff of 28 employees and a single owner. The company serves not only the city where it is located, but also other Brazilian states, such as Rio de Janeiro and São Paulo, attending to customers' requests regarding the quality and quantity of their products.

In order to perform this study, the research sample consisted of 20 employees in a population of 28, since this sample was selected because these employees were directly involved with the manufacture of the products, that is, they are exposed to noise, manual cutting of parts through pointy tools, welding, among others.

C. Instruments

The first instrument used was the Questionnaire adapted from Santos (2010), with 21 closed questions. The objective of this questionnaire was to study the characteristics of the sample that is directly linked to the production of signs and the relation with the functions performed by the employees in the work , as well as questions that involve the use and supply of PPE's, worker safety, training, risk maps, etc. Observations were also carried out under which risks the employees are involved and thus the means to prevent accidents at work and greater comfort and well-being in the environment.

The Digital Noise Dosemeter wireless mode. DOS 700- Instrutherm, was used to make noise measurements of the workplace where employees are exposed. According to [13], the Dosimeter is an integrative meter for personal use that provides the dose of occupational exposure to noise, so the Noise Dosimeter has inside it a processor that allows to calculate the dose of exposure of the user, at various levels for a certain time.

D. Procedures

The adapted Santos Questionnaire (2010) was delivered to the 20 employees of the production sector, on May 7, 2018, it could be answered at home, and returned within 48 hours, so on May 9, 2018, the questionnaires were collected.

The validation of the questionnaire was performed on April 23, 2018, through the program Minitab version 17.1.0. The analysis of the responses in the program was presented with a Cronbach alpha level above the recommended value. According to [14] Cronbach's alpha is directly related to the degree of covariance, so the smaller the sum of the variance of the elements, the more consistent the document.

The observation was made on May 8 and 10 and respected the non-participatory pattern, that is, the applicator did not influence the answers, in order to get accurate data about the reality of the company.

It was carried out in the period from the 20th to the 31st, except for Saturday and Sunday, in August and 03 and 04 September, for two hours a day a visit to the company studied with a work safety technique for noise measurement, in which the worker is subjected during the exercise of his work. For this purpose the dosimeter was placed in the worker's body for at least 1 hour, measuring intervals from minutes to minutes, in order to estimate the sound exposure of a certain period of time.

E. Statistic

For data analysis, such as graphs and the questionnaire itself, Minitab version 17.1.0 was used. [15], cites that this is a statistical software widely used for data analysis, having as main advantage the simplicity of use and for having its window similar to the Excel worksheet.

III . RESULTS AND DISCUSSION

A. Analysis of the noise level

The measurement of the noise level was carried out through the Digital Noise Dosimeter wireless mode. OF 700- Instrutherm where the unit remained in the body of the employee during the working day, which is six hours excluding lunch and coffee time, from 20th to 31 except Saturday and Sunday in August and 3:04 September, in order to know if employees are exposed in the work environment.

The measurements showed that employees are exposed to sound pressure levels ranging from 83 dB to 87.2 dB. No study [16] shows a similar value ranging noise 80 dB to 93 dB. However, the permitted tolerance limit according to NR 15 [7] is 85 dB for continuous or intermittent intervals for 8 hours per day. In figure 1, the average noise measured per day is shown, where the values from 1 to 12 represent, respectively in that order the days 20,21,22,23,24,27,28,29,30,31 in August and 03 and September 4.

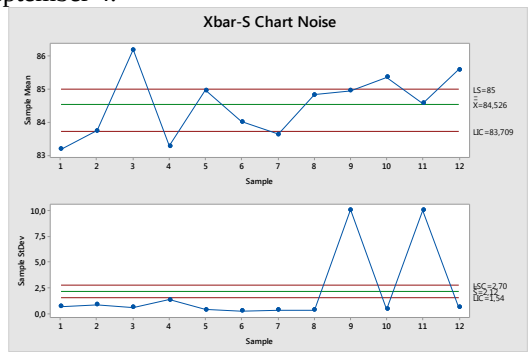


Fig. 1: Control chart x̄-S of the noise levels samples.

As can be observed, the noise in the routine of the evaluated sector provides unfavorable conditions in the work environment, acoustic discomfort and unhealthiness, especially on August 20, 23, 27, 28 (1, 8, 8 and 9) when the noise levels were very close to the limit of tolerance provided in Regulatory Norm 15. This shows the greater incidence of acoustic aspects in this work environment. The time of exposure of workers to approximate indexes may also contribute to possible occupational diseases, mainly hearing injuries and headaches.

B. Questionnaire Adapted from Santos (2010)

Through the Questionnaire adapted from (SANTOS, 2010) one can verify some characteristics of the sample such as length of service, use of PPE, degree of satisfaction in the company, among others.

I found out that 60% of the workers admit on an average of 15 years of work in the metallurgy sector.

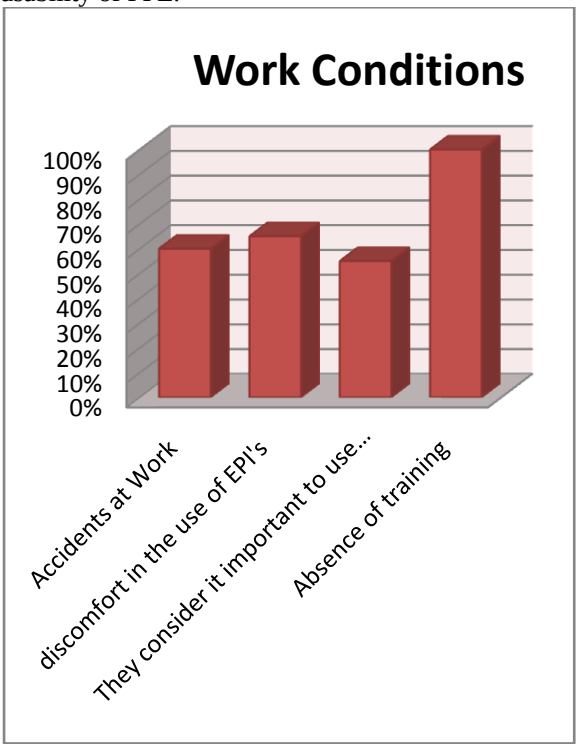
It was found that 100% of the total estimated, indicated the occurrence of an accident, such as cuts in the upper limbs and burns in the manufacturing sector. 60% have suffered some kind of accident and 40% have never had accidents at work. No Article [17] found a similar percentage, with 62% already suffering some type of accident and another 38% never crashed. Of the total, 55% of workers in the sector, said they consider the use of safety equipment important and agree to apply them to the performance of working methods. Another essential aspect analyzed consisted in proving the provision of adequate personal protective equipment for each function. It was identified that the main PPE's used in the workplace are: masks and insertion type ear protectors. There is actually a distribution of these EPI's to employees, but there is no certification on the adequacy of these instruments with the activities carried out. As the signboard production process works directly with welding, sanders, such equipment is indispensable for the worker's safety.

Although 55% of the workers agree on the importance of PPE, only 35% of the evaluated workers admit the use, a not considerable percentage considering the risk indexes related to the sector. Although few of admitting employees who use personal protective equipment, 100% said they did not receive any training regarding the specific use of such equipment, which represents a very significant percentage, and the wrong use can cause really serious damage to health and integrity of the employee, as well as strengthen the action of environmental factors such as heat, dust, radiation, among others, which is characteristic of the production sector.

The level of discomfort regarding the use of PPE was very significant, where 65% of employees in the sector claim that the use of equipment is a nuisance in the performance of their work activity. The annoyance pointed out basically refers to the heat caused by the use of masks and boots. This finding of discomfort effectively affects control of work and employee performance. An alternative to repairing this annoyance could be to link appropriate training in the use of PPE and an educational concept of the company that aims to raise awareness of the need to use such equipment. Although few of the employees affirm the importance and that are willing to use the PPE, it is necessary to teach, encourage, validate that these equipments existences so that the routine of work is more pleasant and safer so they can avoid considerable damages to the workers' health.

The last evaluation regarding the use of PPE covered the frequency of use by the evaluated workers. In the face of the results, it was verified that the frequency of use is not acceptable, about 35%

of the employees affirm to always use the individual protective equipment, through the environmental risks inherent to the work sector, it was expected that the frequency of use was more effective. 65% do not have any use frequency of PPE, the main reason for this is related to the discomfort associated with the use of PPE, where even some of them aware of the risks to which they are submitted, choose to continue not using the equipment that can prevent more serious accidents or future occupational diseases. Graph 2 shows the main aspects regarding the usability of PPE.



Graph 2- Identification of the Usability of PPE's

The lack of training is prevalent, which may be justified by the low use of PPE by employees and although 60% of the number of employees admitted to having suffered accidents and finding the use of important PPE, there is still little dissemination of the use of PPE by two main reasons: discomfort and lack of training.

IV. CONCLUSIONS

The study investigated irregularities pointed out by workers in a metallurgy that is active in the production of letters and logos using stainless steel and galvanized sheet metal. Through visits in the company, it can be verified that there are 28 employees working in the company, of whom 20 operate in the production area that was the object of this study. During the 12 days of research, noise levels peaked on the third day, reaching the mark of 87.2 dB marked in the dosimeter, which may cause discomfort or hearing damage in those who do not use the ear protector or do it improperly. Employees work in inadequate clothing and few use PPE (personal protective equipment) equipment, thus making them more susceptible to accidents in the work environment. Therefore, promoting constant training is a means of minimizing the number of accidents and preventing them from occurring.

After applying a questionnaire to the employees, it could be verified that the satisfaction rate of the same with the working conditions is 30% and that the accident occurrence rate is 60% of the team since among the 20 employees who work in the production area, 12 of them already had some type of accident related to the work and being restricted to cuts with the handling of the plates and burns in the oven used for welding.

According to them, the workplace does not meet the necessary specifications contained in the safety standards at work, putting their employees at risk of injury such as cutting with sharp tools and intense noise.

Thus, it can be concluded that it is an obligation of the employer to make available to his employees individual protection equipment, according to the needs of their functions and also to carry out training on their correct use. It is also important to take care of the health, safety and wellness of its employees and make sure that everything follows the correct terms of safety.

As a suggestion stipulated in the Regulations Norm NR 6, we can mention the use of the shell-type hearing protector, as it attenuates the high noise level, the use of the non-slip boot, protective gloves made of fire resistant material and cut, welding, among other protective equipment with Certificate of Approval (CA) valid at the Ministry of Labor.

REFERENCES

[1] Robinson RK, Franklin GM (2014). Employment regulation in the Workplace: Basic compliance for managers. 2nd ed. ME Sharpe, England, pp.: 3- 5. 10.

[2] Eskandari, D.; Jafari, M. J.; Mehrabi, M..; Pouyakian, , M. ; Charkhand, H. ; Mirghotbi, M. A Qualitative Study on Organizational Factors Affecting Occupational Accidents. Iran J Public Health, Vol. 46, No.3, Mar 2017, pp.380-388.

[3] Neal A, Griffin MA, Hart PM (2000). The impact of organizational climate on safety climate and individual behavior. SafetySci, 34(1- 3):99-109.

[4] Johnson, O. E.; Motilewa, O. Knowledge and Use of Personal Protective Equipment among Auto Technicians in Uyo, Nigeria. British Journal of Education, Society &Behavioural Science 15(1): 1-8, 2016, Article no.BJESBS.24546

[5] Brasil. Portaria Ministro De Estado Do Trabalho E Emprego Nº 1.510 DE 21.08.2009 Disponívelem:http://www.normaslegais.com.br/legislacao/portaria1510_2009.htm. Acesso em agosto 2018.

[6] Previdência social. Anuário estatístico da previdência social 2014. Disponível em: http://www.previdencia.gov.br/2016/03/estatistica-anuario-estatistico-da-previdencia-social-2014-ja-esta-disponivel-para-consulta/. Acessoemsetembro 2018

[7] Prodanov, C. C.; Freitas, E. C. Metodologia do trabalho científico: métodos e técnicas da pesquisa e do trabalho acadêmico.2.Ed. Rio Grande do Sul: Feevale, 2013.

[8] Vergara, S.C..Projetos e relatórios de pesquisa em administração. 7. Ed.São Paulo: Atlas, 2006.

[9] Fonseca, J. J. S. Metodologia da pesquisa científica. Fortaleza: UEC, 2002. Disponível em: <www.ufrgs.br/cursopgdr/downloadsSerie/derad005.pdf>. Acessoem: 15 abr. 2018.NEVES, J.

[10] Andrade, M. M. de. Introdução à metodologia do trabalho científico. São Paulo: Atlas, 1995.

[11] Alves, H.; Cunha, L.M..XII – Software Estatístico: Uma introdução a alguns aplicativos,numa abordagem inicial dos dados. Dossiê Didático,2017 Disponivel em < HTTP:// homepage.ufp.pt/cmanso/ALEA/.Dossier.pdf>

[12] Santos, M. S. dos. Uso do EPI sob o ponto de vista da administração e dos operários da construção civil em feira de Santana.Trabalho de Conclusão de Curso (Graduação em Engenharia Civil) – Universidade Estadual de Feira de Santana – UEFS. Feira de Santana- BAHIA, 2010.

[13] Acurio,E.; Sebastian R.Dosimetria Gel no controle de qualidade tridimensional em tratamento de radioterapia com intesidade modulada e técnicaSmart.Tese de Mestrado em Física Médica,Unibersidade de São Paulo.Acurio (2016)

[14] Santos; S. V. M. dos, et al. Acidente de trabalho e autoestima de profissionais de enfermagem em ambientes hospitalares. Rev. Latino-Am.Enfermagem, Artigo Original 2017;25:e2872 DOI: 10.1590/1518-8345.1632.2872

[15] Cocarelli, T. Por dentro da estatística. einstein: EducContin Saúde. 2011;9(3 Pt 2): 125-7

[16] Silva; J. M. S. dos et al. Método para uso do decibelímetro na determinação da dose diária e nível equivalente de ruído: O caso de uma metalúrgica com ruído intermitente. XXI Simpósio de Engenharia de Produção, 2012.

[17] Souza; A. O. Trabalho em altura na construção civil e as medidas preventivas de segurança do trabalho. Trabalho de Conclusão de Curso (Gradução em Engenharia Civil) – Univerdade Federal do Rio Grande do Norte – Natal – RN,2017.