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ERGONOMIC ANALYSIS OF PRUNING TREES IN CONFLICT WITH POWER LINES

Nayane Amaral Santos[1*], Luís Carlos de Freitas[2], Nilton César Fiedler[3], Elton da Silva Leite[4]

[1] Universidade Estadual do Sudoeste da Bahia/UESB, Programa de Pós-Graduação em Ciências Florestais, Vitória da Conquista, BA- Brasil- nay.amaral82@gmail.com
[2] Universidade Estadual do Sudoeste da Bahia/UESB, Departamento de Fitotecnia e Zootecnia, Programa de Pós-Graduação em Ciências Florestais, Vitória da Conquista, BA - Brasil - luisfreitas@uesb.edu.br
[3]Universidade Federal do Espírito Santo/UFES, Departamento de Ciências Florestais e da Madeira, Jerônimo Monteiro, ES - Brasil - fiedler@cnpq.pq.br
[4]Universidade Federal do Recôncavo da Bahia/UFRB, Programa de Pós-Graduação em Solos e Qualidade de Ecossistemas, Cruz das Almas, BA- Brasil - eltonsleite@gmail.com

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Resumo

Análise ergonômica de poda de árvores conflitantes com a rede elétrica. A poda de árvores conflitantes com redes elétricas está associada a uma série de riscos ergonômicos devido às questões posturais e a exposição às condições físicas pelo ruído e vibração nas atividades laborais. Somam-se ainda os riscos de vida decorrentes de quedas ou contato com a rede elétrica. Objetivou-se com este trabalho aplicar o método EWA (*Ergonomic Workplace Analysis*) e avaliar a exposição ao ruído e à vibração em trabalhadores envolvidos na poda de árvores em conflito com a rede elétrica. A pesquisa foi realizada com prestadores de serviços de uma concessionária de energia elétrica no estado da Bahia. Como resultados à ferramenta EWA, obteve-se classificação de nota regular, sendo observado aspectos preocupantes como a comunicação verbal (diálogo entre os trabalhadores sobre questões técnico/operacionais), adoção postural irregular das costas, braços e ombros, alta demanda de atenção e limitação das atividades. Para as análises quantitativas encontrou-se para a motosserra índices de 84,9 dB(A) para ruído e 2,440 m/s² para vibração, ambos próximos ao Nível de Ação. A vibração da motopoda alcançou 3,703 m/s², superior ao Limite de Tolerância. Como medida ergonômica ressalta-se a importância de pausas, ginásticas laborais e treinamentos. Deve-se ainda buscar o sistema de rodízio na atividade de poda visando à redução da exposição a vibração.
Palavras-chave: Arborização urbana; ergonomia e segurança no trabalho.

Abstract

Ergonomic analysis of pruning trees in conflict with power lines. Pruning trees in conflict with power lines is associated with several ergonomic risks due to postural issues and exposure to environmental conditions, such as noise and vibration in work activities. Additionally, there are life-threatening risks from falls or contact with power lines. The objective of this work was to apply the Ergonomic Workplace Analysis (EWA) method and assess the exposure of workers involved in pruning of trees conflicting with power lines to noise and vibration. The survey was conducted considering outsourced employees that provide services to an electric utility company in the state of Bahia, Brazil. The results obtained through EWA showed a regular risk rate, with concerning aspects, such as verbal communication (dialogue among workers regarding technical/operational issues), irregular posture of back, arms, and shoulders, high attention demand, and activity limitations. Quantitative analysis showed 84.9 dB (A-weighted) for noise and 2.440 m s^{-2} for vibration, both close to the action level. The pole saw vibration reached 3.703 m s^{-2}, exceeding the tolerance limit. The importance of breaks, at-work exercises, and training is emphasized as ergonomic measures. A rotation system should be implemented in tree pruning activities to reduce exposure to vibration.
Keywords: Urban afforestation; ergonomics and workplace safety.

INTRODUCTION

Entrepreneurs have recognized the need for information regarding the risks involved in work activities and monitoring of workers' health. These conditions can be connected to increases in the number of absent workers dependent on the social security systems (Saldanha *et al.*, 2013). Workplace accidents incur a high cost to society, therefore, decreasing them is a shared goal of governments, entrepreneurs, and workers; in addition to social issues related to death and mutilation of workers, their economic significance is also increasing (Mendes, 2013). Occupational risks are evident in tree pruning activities. Operations are performed manually using several hand-cutting tools, such as machetes, saws, pruning shears, and hand pruners, as well as motorized chainsaws and pole saws. Generally, these machines and tools have ergonomic limitations (Oliveira *et al*, 2023). Companies follow laws and regulations regarding Occupational Health and Safety (OHS) to reduce work-related accidents and illnesses; they invest in prevention programs to reduce employee absences due to illnesses or accidents and to lower costs.

Tree pruning in urban areas ensures a harmonious coexistence between trees and power lines. However, this activity is associated with several occupational risks, as it involves electricity and work at heights, which can lead to severe and fatal accidents; therefore, it must be aligned with occupational health and safety. These risks also include noise and vibrations related to the machinery used, which are responsible for occupational diseases that can have irreversible consequences on the health of operators. Thus, the hypothesis raised in this research is that working conditions in pruning trees in conflict with power lines ergonomically impact the health and quality of life of workers.

Pruning of trees conflicting with power lines presents risks associated with working conditions, as operators are commonly subjected to uncomfortable and incorrect postures and stressful situations, and require a high level of attention due to hazards, mainly related to the power lines, cuts, and the heights required for the job. Third parties may also be exposed to risks when isolation and signaling of the pruning area is not properly done. As the work is performed at heights, previous exams are necessary to assess the suitability of the worker for such tasks.

Considering the working conditions at heights, the handling of cutting tools, and the proximity to power lines during pruning activities, this research aimed to analyze whether such conditions pose ergonomic risks and risks of workplace accidents. In this context, the objective of this study was to conduct a quantitative and qualitative analysis of ergonomic risks to understand the situation of workers involved in activities of pruning trees in conflict with power lines.

MATERIAL AND METHODS

Study area

The study was conducted in a company providing services to an electrical utility company in the southwest region of Bahia, Brazil, evaluating the activities of pruning and/or cutting branches and trunks of trees conflicting or potentially conflicting with power lines in urban and rural zones of 12 municipalities. The pruning was managed by teams composed of pruning coordinators, pruners, and pruning assistants.

Operational characterization of the pruning process

The pruning activity in the company is performed in phases by team members. The tools and equipment that integrate the process are shown in Figure 1.

Figure 1. Operational process of pruning trees conflicting with power lines. A - Signaling; B – Completion of the Preliminary Risk Analysis (PRA); C - Ladder position; D - Height work kit positioning; E - Pole saw; F- Process operation with chainsaw; G – Cut logs; H - Material storage.

Figura 1. Processo operacional de podas de árvores conflitantes com a rede elétrica. A – Sinalização; B – Preenchimento da Análise Preliminar de Risco (APR); C – Posicionamento da escada; D – Posicionamento do Kit de trabalho em altura; E – motopoda; F – Operação de processamento com motosserra; G –Toras traçadas; H – Guarda de materiais.

Tasks were distributed according to the job function (coordinator of pruning operations, pruner, and pruning assistant) and carried out using personal protective equipment (PPE) and collective protective equipment (CPE).

Data collection

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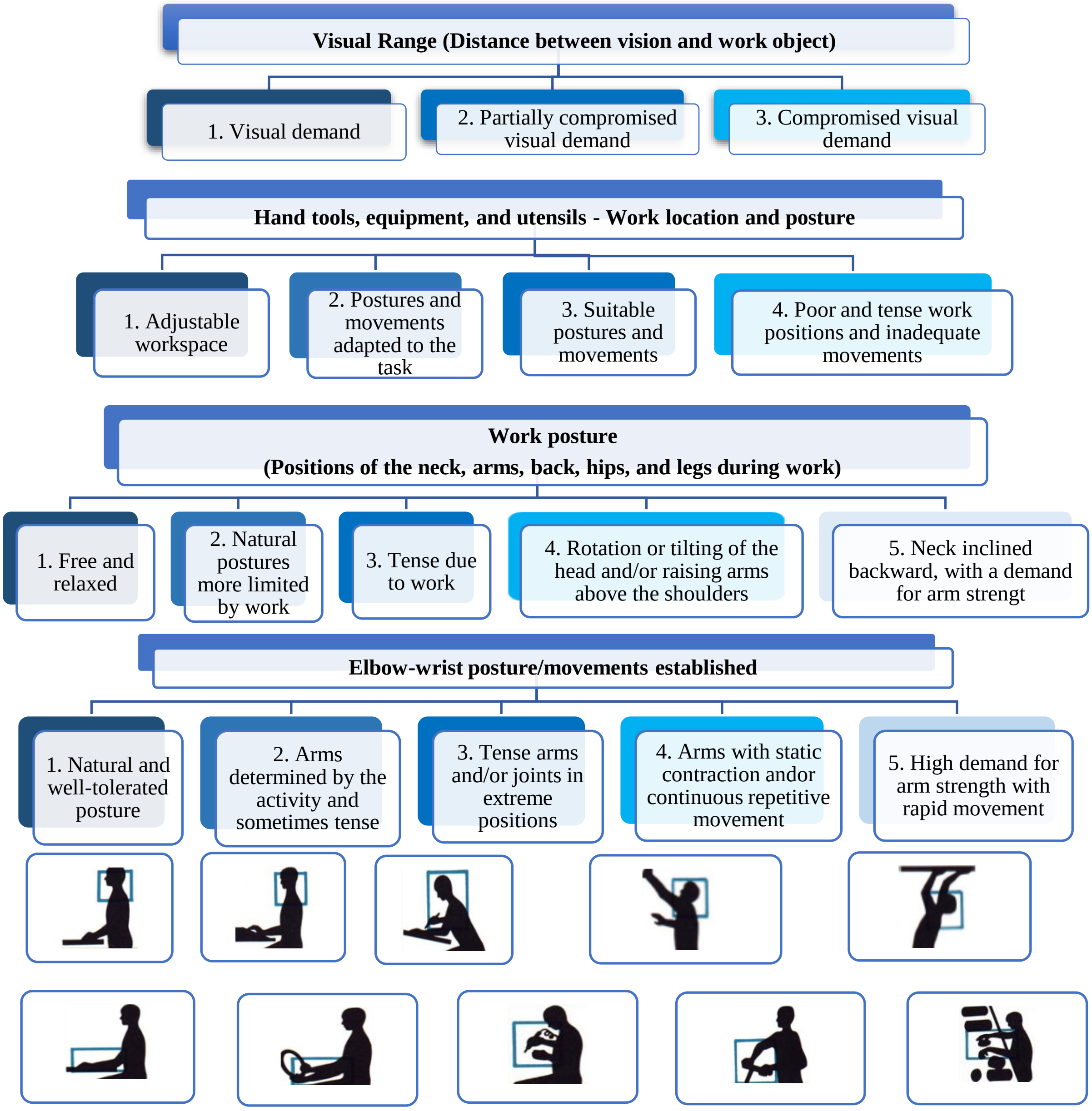
The research population consisted of 12 teams, with 26 workers sampled, including 15 pruners and 11 pruning assistants, representing 50% of the total workforce of the company. The data were divided into two types of assessments: qualitative assessment using the Ergonomic Workplace Analysis (EWA) tool; and quantitative assessment of environmental risks inherent to noise and vibration levels.

Qualitative assessment

Data were collected through interviews with pruners and pruning assistants based on the EWA tool. Ergonomic risks were qualitatively evaluated based on the responses obtained from the interviewees and the EWA tool operator. Parameters were classified using a scale from 1 to 5, where: 1 represents a situation with the least deviation from optimal or acceptable conditions for the work's spatial arrangement; 2 and 3 represent acceptable situations, with no significant deviations; and 4 and 5 represent working conditions or environments that may potentially cause harm to health.

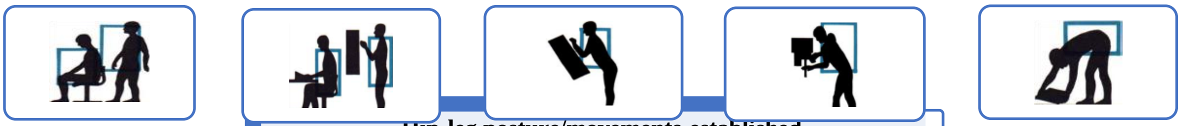
After grading, the answers of the interviewees and the ergonomic tool operator were compared and classified by job function (pruner and pruning assistant). These comparisons were classified using the following criteria: good (+ +), regular (+), poor (-), and very poor (- -). Qualitative analysis was conducted, divided into topics addressing physical and psychological aspects.

Table 1. Qualitative assessment of ergonomic risks for the activity of pruning trees in conflict with power lines.
Tabela 1. Avaliação qualitativa dos riscos ergonômicos para a atividade de poda conflitantes com a rede elétrica.



Back posture/movements established

1. Natural and well-tolerated posture
2. Suitable position but limited by work
3. Inclined and/or poorly supported
4. Inclined with unsupported rotation
5. Harmful posture during heavy work



Hip-leg posture/movements established

1. Free posture with voluntary alteration
2. Suitable position but limited by work
3. Activity poorly supported or performed inadequately and standing
4. Standing and static posture, on one foot or kneeling
5. Heavy activity, adopting a harmful posture

Work restrictions
(Circumstances of restricted work, movement limitation, and freedom in performing the activity)

1. Limited by processes and machinery
2. Casual limitation with a need for concentration
3. Completely limited by processes and machinery

Communication among workers and personal contacts
(Verbal communication among colleagues and superiors during work execution)

1. Communication and contact among workers
2. Communication limitation (location, noise, concentration)
3. Total limitation in communication and contact at work (isolated)

General physical activity - Workload

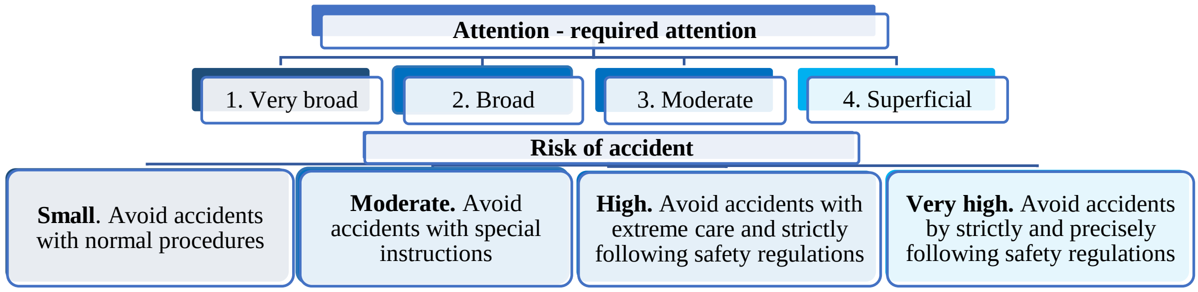
1. Physical activity determined by the worker, without work peaks
2. Occasional work peaks without excessive effort
3. Risk of excessive effort due to frequent workload peaks
4. Reasonably heavy workload without breaks and high peaks

General physical activity - Workspaces

1. Workspaces almost do not limit work movement
2. Workspaces limit movement (only during breaks)
3. Workspaces allow proper movement
4. Reasonably heavy workload without breaks and high peaks.

Attention cycle length - Observation of the worker in his activity

1. Superficial (< 30%)
2. Moderate (30% to 60%)
3. Broad (60% to 80%)
4. very broad (> 80%)



Quantitative assessment

Two environmental risks associated with tree pruning activities were quantitatively evaluated: noise and vibrations. Quantitative measurements were conducted following the parameters of the Occupational Hygiene Standards (NHO) from Fundacentro.

Noise

Noise was measured in two sampling situations: measurement of the overall hourly workload and individual measurement of pruning machines. Measurements were carried out on different days and followed all the parameters of NHO 01 (NHO 01, 2021). Noise was measured using a dosimeter (Type 2; THE EDGE model, serial number EHQ 06004; with a sound level calibrator 2010212, serial number 150709919). The following criteria were used to configure the dosimeter: "A" weighting circuit; slow response circuit (slow); criterion level of 85 dB(A); integration threshold level of 80 dB(A); and a dose multiplication factor (Q-5) of 5 dB(A). Data were processed on a computer using a Data Logger.

Vibration

Hand/arm vibration was quantitatively assessed through sampling of the hourly workload of pruners, following the technical procedure of NHO 10. The measurement was performed using a vibration meter (SV 105A, SVANTEK, serial number 43473). An accelerometer was positioned in the pruner's hand, and the meter was attached to their waist. The criteria used to configure the vibration meter were: configuration for hand-arm measurement system; meter connected to a triaxial accelerometer; and calibration with a sensitivity value of 0.684 μ V/ms².

Statistical analysis

Statistical analysis was applied to the qualitative ergonomics data, considering as variables the topics used through the EWA tool for interview about the activities of pruners and pruning assistants. Statistical analyses were conducted using the program SAEG 9.1. Lilliefors normality test at a 5% probability level was applied to check for normal distribution of the analyzed data; non-normal data were subjected to non-parametric Spearman correlation analysis at a 5% probability level. The analysis of data from the EWA tool considered the qualification provided by the tool through adjectives to the answers obtained by the tool operator and the interviewer.

RESULTS

Table 2 illustrates the EWA tool applied in the ergonomic analysis of pruning trees in conflict with power lines.

Table 2- Analysis of the responses from the Ergonomic Workplace Analysis (EWA) tool for activities of pruning trees in conflict with power lines.
Tabela 2- Análise das respostas da ferramenta Ergonomic Workplace Analysis (EWA) para atividades de poda de árvores em conflito com linhas de energia.

Evaluated parameters	Results
Application of EWA tool	Regular (46.2% pruning assistants) Regular (38.5% pruner)
Adoption of posture	High posture (60%)
Visual range	Free and partially compromised visual demand
Hand tools, equipment, and utensils	Adjustable workspace, postures, and movements (100% - pruning assistant) Inadequate postures and movements (6.7% - pruners)
Posture during work	Head rotation or tilting and arms tilting above the shoulders (20%)

(Neck-Shoulders)	Free and relaxed posture of shoulders and neck (80%)
Posture during work (Elbows-Wrists)	Natural and/or tolerable postures and slightly tense (73.4% - pruner) Natural and/or tolerable postures and slightly tense (81.8% - pruning assistant)
Posture during work (Back)	Natural and tolerable posture (46.7%) Natural and tolerable posture (54.5%)
Posture during work (Hip-Legs)	Natural and tolerable posture (33.3% - pruner) Natural and tolerable posture (54.5% - pruning assistant)
Work Restrictions	Totally limited by processes and machinery (80% - pruner) Totally limited by processes and machinery (90.0% - pruning assistant)
Communication among workers	Communication and contact among colleagues (81.2 % - pruning assistant) Communication and contact among colleagues (53.3% - pruner)
General physical activity – Workload	Frequent work peaks without excessive effort (66.7% - pruner) Frequent work peaks without excessive effort (54.5% - pruning assistant)
General physical activity - Workspace	Workspaces limit movement (66.7% - pruner). Workspaces allow proper movement (54.5% - pruning assistant)
Required attention	Wide (64% - pruning assistant) Very wide (40% - pruner)
Attention cycle length	Between 60 and 80% (46.7% - pruner) Higher than 80% (45% - pruning assistant)

Statistical analysis of data from the Ergonomic Workplace Analysis (EWA) tool

According to non-parametric Spearman correlation analysis, several items observed with the EWA tool showed significance, confirming the ergonomic correlation of the analyzed activity (Table 3).

Table 3- Non-parametric Spearman correlation indices at a 5% significance level for assumed height, visual range, hand tools, neck-shoulder posture, elbow-wrist posture, back posture, communication, and required attention during activities of pruning trees in conflict with power lines, evaluated using the Ergonomic Workplace Analysis (EWA) tool.

Tabela 3 - Índices de correlação não paramétrica de Spearman a 5% de significância para altura assumida, alcance visual, ferramentas manuais, posturas adotadas do pescoço-ombro, posturas adotadas do cotovelo-punho, posturas adotadas de costas, comunicação e atenção demandada durante atividades de poda de árvores em conflito com linhas de energia, avaliadas por meio da ferramenta Ergonomic Workplace Analysis (EWA).

Variables	Visual range	Hand tools	Posture adopted			Communication at work	Required attention
			Neck-shoulder	Elbow-wrist	Back		
Assumed height	0.6455*	0.7873*	0.6928*	0.4878*	0.6970*	0.6348*	0.6217*
Visual range		0.7899*	0.8681*	0.7516*	0.8661*	0.9391*	0.7797*
Hand tools			0.8842*	0.7509*	0.8699*	0.8237*	0.7268*
Neck-shoulder posture				0.8786*	0.9710*	0.9220*	0.8143*
Elbow-wrist posture					0.8433*	0.8270*	0.7572*
Back posture						0.8938*	0.7885*

Some evaluated parameters showed a direct and significant correlation. The height adopted by the pruner provides better visual range, however, this item affects the posture adopted, compromises communication, and hinders attention during the pruning process.

Quantitative assessment of vibration and noise

Vibration

Vibrations levels of 3.703 and 2.440 m s^{-2} were found for the pole saw and chainsaw, respectively. Vibration oscillations during the activities performed with the pole saw and chainsaw during the process of pruning trees conflicting with power lines are shown in Figures 2 and 3, respectively.

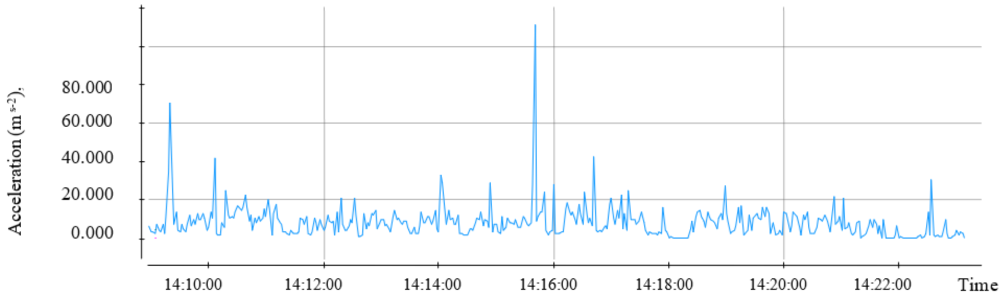


Figure 2- Graphic illustration of hand/arm vibration levels emitted by the pole saw.
Figura 2- Demonstração gráfica dos índices emitidos pela motopoda na avaliação quantitativa de Vibração de Mãos e Braços - (VMB).

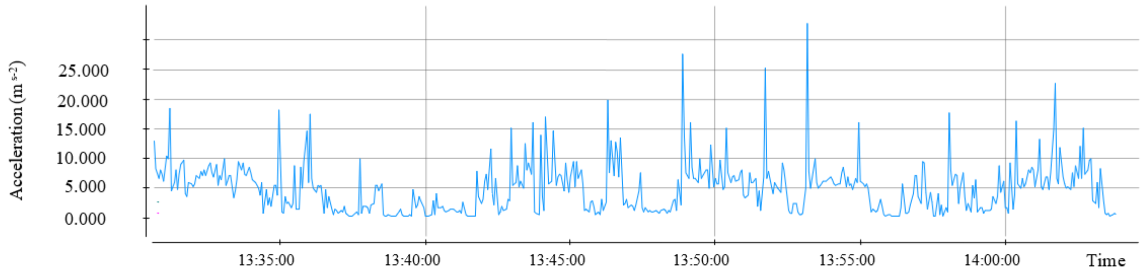


Figure 3- Graphic illustration of hand/arm vibration levels emitted by the chainsaw.
Figura 3 - Demonstração gráfica dos índices emitidos pela motosserra na avaliação quantitativa de vibração de mãos e braços.

Noise

The quantitative noise assessment showed a dose of 84.9 dB(A) for eight hours of work. However, peaks above 100 dB(A) at certain times were recorded (Figure 4). According to the individual noise measurement of pruning machines, the results found for chainsaw and pole saw varied and exceeded the tolerance limit. The chainsaw emitted 102.7 dB(A) whereas the pole saw emitted 91.0 dB(A). Noise oscillations for the chainsaw and pole saw due to operational processes are presented in Figures 4 and 5, respectively.

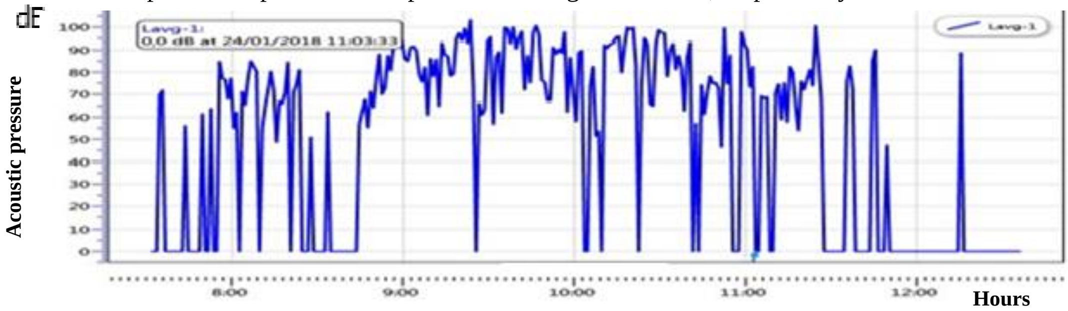


Figure 4- Graphic illustration of continuous noise levels emitted by the chainsaw.
Figura 4 - Demonstração gráfica dos índices emitidos pela motosserra na avaliação de ruído contínuo.

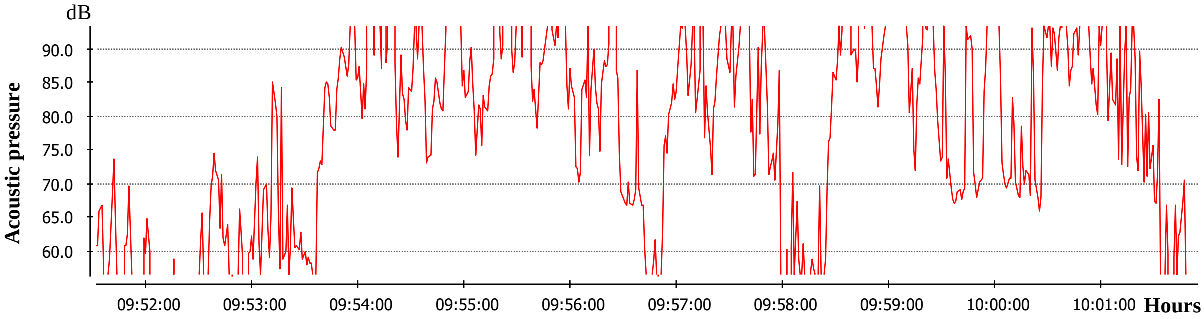


Figure 5- Graphic illustration of continuous noise levels emitted by the pole saw.
Figura 5 - Demonstração gráfica dos índices emitidos pela motopoda na avaliação de ruído contínuo.

DISCUSSION

Analysis of data from the Ergonomic Workplace Analysis (EWA) tool

Assumed height and visual range during work

Pruners always choose to position themselves at the highest height during tree pruning activities to obtain a better visual range. The higher the pruner is, the closer to the branches, the better the visibility, and the lower the possibility of damaging the electrical wiring due to falling branches. However, this practice increases proximity to power lines and the pruner's working height, increasing the risk of accidents (falls and electrical shocks). Working at higher heights also requires more energy expenditure, as the operator climbs the trees equipped with personal protective equipment (PPE) and heavy tools, making the operation more exhausting.

Accident risk assessment is important because it contributes to improving practices, ensuring greater safety and well-being for workers (OLIVEIRA, *et al.*, 2023), preventing risks of falls, electrical shocks, and serious machine-related injuries. According to Fiedler (2011), manual handling of loads and uncomfortable postures have the potential to cause ergonomic problems, representing a risk of injuries that will require treatment and rehabilitation.

Assumed height and communication among workers during work

The pruner's workplace hinders communication, requiring a louder voice for information exchange during work activities. Moreover, the communication process is still aggravated by operational aspects (machine noise), making communication, or understanding between operators even more difficult. According to Toscan (2017), hearing is essential for a chainsaw operator to communicate with people in the work environment. Therefore, equipment and machinery should be subjected to continuous maintenance to mitigate the potential negative impacts of noise levels that interfere with communication.

Visual range and postures adopted during the tree pruning process

Operators adopt strenuous neck-shoulder, elbow-wrist, and back postures for a better visual range, which can cause lumbar, dorsal, and joint problems when these activities are frequent. Mitigating such impacts requires operators to adopt strategic and safe positions during tree pruning activities. Lopes *et al.*, (2013) reported that arms and legs are the most demanding body parts during manual tree pruning due to the need to keep arms always extended and maintain a standing posture during a significant part of the workday.

Manual tools and postures (neck-shoulders, elbows-wrists, back)

The correlation of these factors directly impacts the health and safety of the evaluated workers, as heavy and defective equipment makes pruning more difficult, leading to uncomfortable postures that can result in health issues. The lack of training in handling pole saws and chainsaws also can cause inadequate posture, increasing the risk of accidents. Rêgo *et al.* (2016) emphasized the importance of postural and operational training, as well as continuous search for lighter and more modern chainsaws. The chainsaw generates ergonomic problems due to its handling (weight manipulation), excessive pace, long working hours, repetitiveness, stress, anxiety (TOSCAN, 2014), and inadequate posture (MEDEIROS; JURADO, 2013; TOSCAN, 2014). According to Mendes (2013), humans have limited physical strength; their musculoskeletal system enables them to perform movements at high speed and with a wide range but with low resistance. Therefore, continuous training and development programs for employees are important for improving working conditions and reducing accident risk.

Required attention and other ergonomic aspects addressed by the EWA tool

The attention item showed 100% significance when correlated with the ergonomic items assessed using the EWA tool. This reflects the workers' awareness of the risks involved in the activity. Risks can increase in work at high due to simple failures, such as the operator's lack of attention to the correct use of safety equipment. In some cases, failure in using the safety belt attached to the guide can compromise safety during the operation, with potential to result in serious accidents.

The work restriction item did not show significance when correlated with most ergonomic items, indicating little restriction during work activities. However, restrictions on handling heavier equipment may occur, as a higher workload may occur, which, combined with the effects of the postures adopted by the worker, can increase the risk of injuries during work activities. According to Torres *et al*. (2014), overloading can lead to muscle fatigue, pain, inflammation, and injuries to the muscles and lower limb ligaments.

Analysis of responses obtained with the EWA tool

Arm height during work

Raising the arms is common in these activities, as pruners often work below power lines while pruning branches located above their heads, requiring them to raise their arms. According to Lopes *et al*. (2013), the forestry sector has activities, such as manual and semi-mechanized pruning, that affect the ergonomics of workers, resulting in biomechanical problems.

Visual range

The proximity to power lines requires the pruner to have a clear visual range to facilitate pruning and avoid safety problems. However, they often adopt inappropriate and detrimental postures to their health to achieve a better visual range. Therefore, mitigating these problems requires the disconnection of power transmission lines for performing these activities, minimizing stress, physical exhaustion from inappropriate postures, and accident risks. Additionally, regular clinical examinations and workplace exercises are important for improving the quality of life for these workers.

Hand tools, machinery, and utensils

Tree pruning involves manual transportation of machines and equipment, pruning on ladders, cutting, and transportation of branches, which often result in pain, discomfort, and even stress for operators. Mitigating such problems requires reducing the length of branches and stumps during the cutting process to minimize the physical effort required during handling and transportation of woody material. According to Rêgo *et al*. (2017), the operator should avoid twisting the lumbar spine and trunk when handling the chainsaw, stiffening the spine before manipulating the load to keep the muscles in adequate conditions for the required effort.

The tree pruning operation promotes the adoption of inappropriate postures and standing work by workers during almost the entire working day. The ergonomic evaluation of the activity is important and necessary for the implementation of improvements, such as the practice of breaks and labor exercises, which contribute to health and reduction of potential harm and discomfort. The safe and productive execution of an activity directly depends on a harmonious set, composed of the worker, equipment, and suitable locations based on work organization, occupational health and safety legislation, and certifications assumed by organizations (SCHETTINO *et al.*, 2016).

Posture and movements during work (neck-shoulders, elbows-wrists, back, hips-legs)

Tree pruning activity generates neck and shoulder tension and arm fatigue, as pruners often need to handle machines and make precise movements with their arms raised. According to Hammer and Mcphee (2016), holding and pushing cutting machines overload the neck and shoulders. Regarding hips and legs, it is assumed that the function requires free postures and movements, sometimes involving physical strength to cut, bend, move logs, or transport branches removed during pruning.

Communication among workers and personal contacts

Communication limitations are a serious issue during tree pruning activities, usually caused by machines, which impairs the operator's attention and concentration, exposing him to greater risks. The operator, therefore, needs maximum concentration, especially when pruning near low voltage power lines, where falling branches can cause short circuits.

Required Attention

Attention during tree pruning activities is constant and can impact worker mental health and fatigue, affecting productivity and increasing the likelihood of accidents. Work pace, attention, and reasoning decrease as fatigue increases, making the worker less productive and more prone to errors and accidents.

Vibration quantitative assessment

The vibration levels varied between the evaluated machines. The pole saw requires the suspension of the upper limbs, reducing stability in receiving vibration waves due to the lack of support and firmness. According to Saha and Kalra (2016), grip strength, elbow angle, resonance frequency, and grip diameter affect the vibration transmitted to hands and arms; therefore, handling techniques and tool and workstation designs should be considered.

The vibration level found did not exceed the tolerance limit of 5.0 $m\ s^{-2}$ for the hand/arm vibration established by NR 15; however, it exceeded the 2.5 $m\ s^{-2}$ level characterized as the action level. Schettino *et al.* (2018) evaluated ergonomics during forestry harvesting in areas with wind-damaged wood and found levels of 4.86 $m\ s^{-2}$, which is lower than the tolerance limit but higher than the action level. Both situations require the attention and action of companies through safety procedures (individual and collective) and health care with medical monitoring. According to Langer *et al.* (2015), vibrations can result in neurological, muscular, and vascular disturbances and cause osteoarticular injuries to hands and arms.

Noise quantitative assessment

The noise level found deserves attention because. It was slightly below the tolerance limit but exceeded the action level for noise (80 dB(A) established by NR 09 of the Brazilian Ministry of Labor and Employment, which considers a dose of 0.5 for action level, i.e., 50% of the reference value for an eight-hour workday, which is 80 dB(A) for a dose of 85 dB(A) (BRASIL, 2017).

Considering that the noise level found exceeded the action level, preventive measures should be established to ensure the healthiness of pruners exposed to these noises, as communication and cognition can be compromised from 80 dB(A) onwards.

Noise spikes were recorded, despite the mean dose bellow the tolerance limit. Peaks above 100 dB(A) were recorded, which is high due to eradication, which is an activity that exerts greater acceleration, therefore, greater engine speed and higher noise level.

Noiseless periods also were observed, when the pruners turned off the chainsaw to move from one tree to another. These noise emission breaks are positive, as they contribute to the reduction of exposure noise dose and, consequently, the worker's health.

CONCLUSIONS

- Ergonomic conditions during the activity of pruning trees in conflict with power lines were regular when evaluated using the Ergonomic Workplace Analysis (EWA) tool.
- The work activity evaluated showed the potential for occurrences of occupational diseases among workers, highlighting the importance of adequate ergonomic postures when carrying out the activities;
- The pruner function is the most impacted by environmental risks of noise and vibration due to direct exposure during the operation of chainsaws and pole saws;
- The vibration and noise levels found impact the workers' health. Therefore, the adoption of measures to reduce exposure to these factors is essential to prevent occupational diseases, including scheduled breaks, availability of personal protective equipment and control of its proper use, equipment maintenance, and periodic health check-ups.

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