

# Preliminary Labor Ergonomic Analysis Applied to a Brazilian Solid Materials Recycling Cooperative

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## Abstract

The key to successfully develop a program to enhance safety and ergonomics in the workplace is an innovative process that aims to reduce workplace injury levels as well as minimize risks. This can be achieved by raising awareness and changing employees' behavior. Nowadays managers tend to strive for improved efficiency and productivity in all sectors. However, the growing demand for greater productivity has put the employees' health and well-being at great risk. Following another trend, the enterprise under study is based on the principles of solidarity economy that aims to guarantee self-management processes, focusing on the human health and wellbeing rather than financial profits. Based on the ergonomic questionnaire results and the follow-up of the co-workers' routine, some forms of improvement to accomplish their tasks were suggested.

**Keywords:** Human Factors, Solidarity Economy, Ergonomic Analysis.

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## 1. INTRODUCTION

Solidarity economy has spread as a possibility of survival by population segments excluded from the formal labor market. It manifests itself in different organizational forms built upon general principles of self-management, characterized by more democratic decision-making, social relations of cooperation between people and groups, and horizontality in social relations in general [1]. This possibility establishes, therefore, a "new" form of production, consumption, and distribution of wealth centered on the value of the human being, building an alternative to the alienating dimension of dehumanized work. It also includes a multidimensional character, involving social, economic, political, ecological, and cultural aspects, in the perspective of building a fair and sustainable society.

The work with this recycling cooperative raised the need for reflection on the issue of health and ergonomics in the work developed by these cooperatives. This is because the construction of self-managed relationships does not in itself assure safer working conditions, especially in view of the daily urgency for securing a minimum subsistence income. Thus, the precarious structural conditions and the risks faced in everyday work in this association indicate that the issue of ergonomics, health, and safety is pivotal also in solidarity economy projects.

According to [2], ergonomics is the study of the relation of man and his work, equipment, and environment, and the application of knowledge from different areas in solving problems that arise from this relationship. Ergonomics is divided into three specific characteristics, which can be addressed as physical, cognitive, and organizational ergonomics.

All subdivisions of ergonomics are integrated in today's organizations without neglecting efficiency and productivity. Thus, in the classical method of activity ergonomics, ergonomic analysis of work has been consolidated in the labor sciences as an effective instrument to operationalize the perspective of understanding work in order to transform it [3]. From a contemporary point of view, the world of labor is undergoing accelerated transformations

associated with a productive restructuring process with negative indicators on the health and safety of workers. Examples include work-related epidemics of musculoskeletal diseases, cases of burnout syndrome, and an increase of work accidents [4]. The sense of intensification of work, with performance at the limit of capabilities, has become more and more common in workers' reports.

Although relative to productive processes, in which the worker is in a subordinate condition, the rupture with the mental suffering to which workers have already been submitted by their previous experiences of dehumanized work, is one of the major challenges faced by solidarity economy projects [5]. Despite of the challenge, this reflection cannot be avoided, given the risk of replicating in cooperatives the precarious conditions and health risks found so often in production-driven organizations. Thus, it is relevant to penetrate into the daily life of these subjects, to understand the meaning they attribute to their own work, as well as to perform a profound evaluation of ergonomics, health, and work safety aspects.

## **2. METHODOLOGY**

A preliminary analysis was carried out to choose the most suitable method to achieve the best results with respect to the reality of cooperatives. The inductive method was adopted, with emphasis on a descriptive approach to develop first a qualitative analysis and then a quantitative survey corresponding to the field of study of the work. Descriptive research seeks to discover, as precisely as possible, the frequency of a phenomenon, its relation and connection with others, as well as its nature and characteristics.

Based on these factors, a descriptive study was developed supported by a survey and interviews with employees of a cooperative to gather information about their feelings and perceptions regarding ergonomics. A total of 10 cooperative workers were interviewed during the development of their tasks.

Assessment of the workplace was carried out through visits to the cooperative during working hours to record the real routine of a worker in the cooperative's space. Thus, monitoring was performed in such a way that allowed the perception of the real conditions and challenges faced in this sector. After this observatory phase, relevant information was recorded concerning the working environment of the cooperative during separation of recyclable material.

Based on this assumption, a 10-question survey was applied to the workers to seek a qualitative knowledge of the work environment of the company that contributed to the ergonomic understanding of the operations. Next, workers from sorting, fine material disassembling, and loading and unloading of material, were interviewed to obtain more information about the general context of the separation, such as the difficulties faced in the process, characteristics of the posture at work, workload, productivity, and ergonomic concerns within the organization.

The administered survey was adapted from [6], which represents an elaborate tool allowing the worker to express his/her perception regarding the workplace and the activity performed, informing whether he/she feels discomfort, difficulty or fatigue, in what intensity, and whether this is related to the work executed. The number of questions of the survey was reduced from 11 to 10. The survey was administered orally, taking into account the accelerated work routine and the personal effort of each cooperative worker, thus, avoiding any pauses during working hours. In addition, due to the low level of education of the workers, an oral survey eases the understanding of the questions and provides a more realistic response.

The data were submitted to a qualitative analysis, defined by parameters described in the literature. Using the level of satisfaction and/or dissatisfaction of the worker with respect to the degree of difficulty and/or ease pointed out by the information relative to the study environment, it was possible to verify some aspects of the man-machine-environment interaction fundamental to ergonomic analyses.

### 3. RESULTS AND DISCUSSIONS

This section deals with aspects of work organization and the results and discussions regarding the administered survey, with the aim of identifying the main regions of the body affected by pain and discomfort, as well as to detect work situations more likely to cause injury. The results allowed the development of proposals to promote a process of search for ergonomic improvements in several tasks, in order to preserve the health and improve the comfort and well-being of the cooperative workers during the working hours.

#### 3.1 Ergonomics In The Cooperative Work

The information gathered from the visits and monitoring of the cooperative workers' routine in the work space was sufficient to trace some aspects of the ergonomic reality in this sector of production. Techniques and methods used in the areas of sorting, pressing, and loading and unloading of recyclable materials were observed and recorded.

The first noticeable impression was the non-use of personal protective equipment (PPE) by a large number of cooperative workers in the different production stages. It was clear that some of the workers use PPE and maintain an adequate level of safety, aiming at preventing accidents and unhealthy situations. However, others do not use PPE and show a lack of interest in their use. This practice has a great influence on the final outcome of the operations, since adoption of suitable safety measures could prevent accidents. Moreover, this would allow decreasing the risk of accident and discomfort inherent to the nature of the task performed.

The PPE routinely neglected by most workers was the protective respiratory mask. Respiratory masks are essential for workers to handle materials with odors and biological agents. In addition, there is dust and animals in the workplace that can transmit diseases. Most workers use gloves that prevent against pathogens, glass cuts, metals, and pointed objects (puncture-sharp). These also offer some protection to chemicals, mitigating and preventing to some extent the occurrence of accidents. However, there is a lack of safety in the unloading of the unseparated materials, since it is not possible to have prior knowledge of the type of material present, causing several accidents in the lower limbs (legs). This makes it necessary the use of leather shin guards that can prevent the contact of legs with any type of perforating object.

With respect to workers who wear gloves and work with PPE in the dismantling of parts (Figure 1), they can still be found working in awkward positions and tend to strain the spine, exposing the body to an irregular labor. Due to the absence of adequate furniture the conditions are precarious, typical of the adaptation of man to work in situations of complete discomfort, aiming only at productivity. Although initially the financial results overcome the labor difficulties, in the long term the worker is not able to maintain its productivity, entering into decline.



**FIGURE 1:** Cooperative Worker Disassembling Parts.

Thus, weariness associated with the repetition of inappropriate postures interferes directly in the personal productivity and later on the whole group's productivity, since the former affects the

cooperative's business, impacting on the collective profits. The permanence of the worker for long periods in this position causes the loss of labor capacity in the long term, in addition to exhaustion during the working day. Another noteworthy point concerns the non-use of uniforms and adequate PPE, thus, bearing some parts of the body totally unprotected during activity.

These same postures can be observed in several other stages of the separation process, causing discomfort and weariness to the upper areas of the body, such as the cervical spine, lower back, shoulders, and arms (Figure 2). The discomfort caused by prolonged exposure to an improper position may cause physical exhaustion and pain that may impair the worker's personal productivity. This situation should be mitigated by the use of workbenches and/or conveyor belts to facilitate the movement of materials and improve the posture of workers throughout the handling of recyclable materials and other equipment.



**FIGURE 2:** Cooperative Worker Bent During Materials Sorting.

During the pressing stage, workers bend the body forward to force the recyclables into the machine, which causes discomfort in their spine (Figure 3).



**FIGURE 3:** Cooperative Workers Operating The Press.

Next the workers tie the load in a harmful position and remove the load from the press in an irregular crouched position, using force to open the press machine. The more uncomfortable and exhausting the operation, the slower and unproductive the worker becomes, compromising the pressing time and reducing the material flow.

After the separation stage, it is common to observe workers pulling bags filled with material to the loading area near the vehicle which collects the separate materials for sale. The workers carry the bags with their arms turned back further damaging the cervical spine, lower back, shoulders, and arms. Next, the bags are loaded into the transport vehicle.

This stage is a period of great pain and physical effort for the workers. They have developed a particular method for strategically allocating all the bags on the top of the vehicle. This requires a worker on the top of the vehicle to pack the bags, while at least two other are responsible for lifting the bags from the ground level with their arms (Figure 4).



**FIGURE 4:** Loading of The Bags For Sale.

This operation demands extreme strength of the workers, who in turn do not adopt safety measures. Furthermore, this operation exposes the worker on top of the vehicle to the risk of falling while the others are forced to inhale dust and several microorganisms present in the environment. The accomplishment of this task demands a risk evaluation, platforms, and the use of a safety belt to work at height in compliance with the Brazilian regulatory norms, which are not properly respected.

Throughout the entire production line, materials are separated and concentrated; those with no commercial value are discarded for waste. This operation forces the workers to carry the objects through long distances either pulling them in large containers (Figure 5), or using improvised carts.



**FIGURE 5:** Cooperative Associates Transporting Materials.

Both methods expose workers to inappropriate physical efforts and postures, causing pain and fatigue. This practice damages the lower back, arms, and spine, directly affecting the worker's productivity.

### 3.2 Application of The Ergonomic Survey

Application of the ergonomic survey allowed establishing a relationship between the worker's tasks and the parts of the body affected by discomfort and pain establishing a link with a specific work sector. Further, the qualitative and quantitative approach used allowed to analyze and evaluate some factors related to the non-application of the best ergonomics practices:

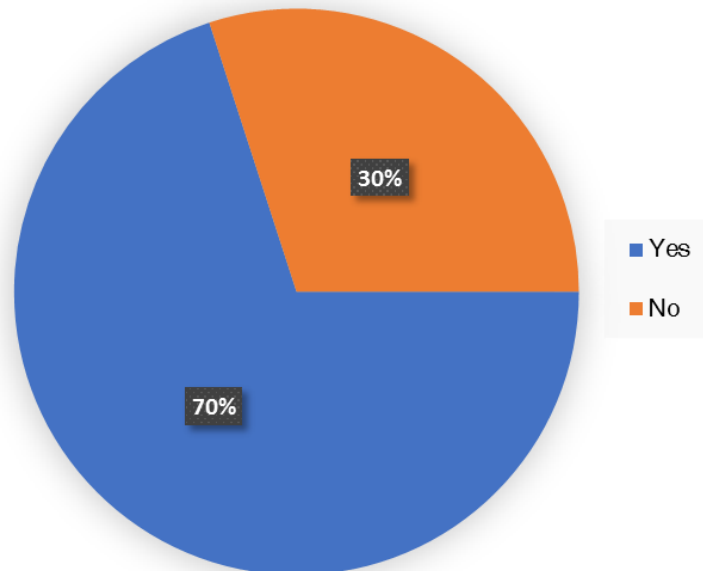
- Tenure at the cooperative;
- Workload;
- Relationship between discomfort/pain and work;
- Region of discomfort;
- Intensity of discomfort/pain;
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With regard to the first factor, "tenure at the cooperative", there is a probable relationship between the time workers are associated with the cooperative and the existence of more intense discomfort/pain in several, upper and lower, limbs.

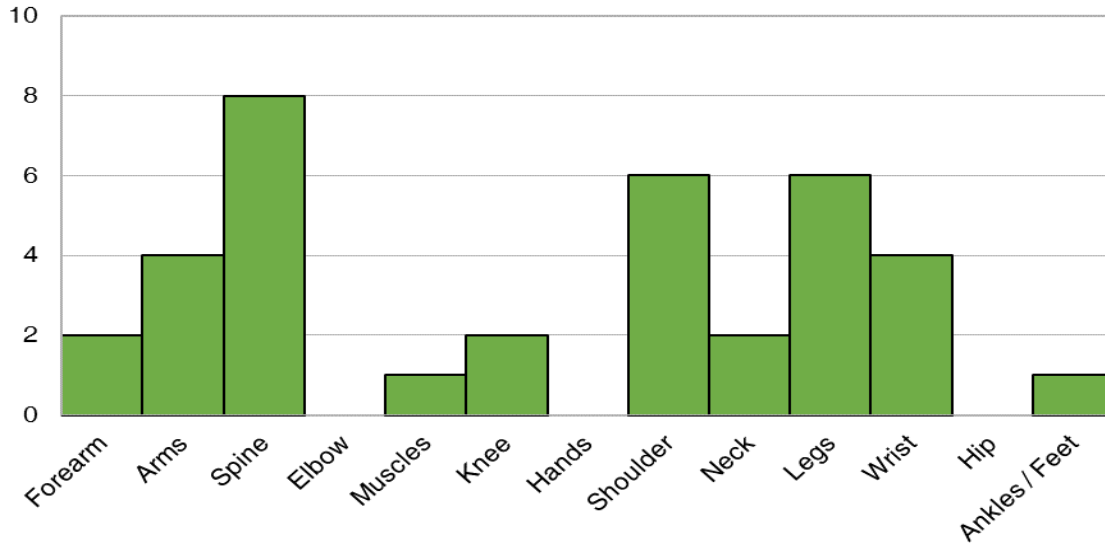
Concerning "workload", in general all cooperative workers work 8 hours per day and 4 hours at the weekend, totaling 44 hours a week. No influence of this factor was identified on the evaluated problems.

With respect to the "relationship between discomfort/pain and work", most of the workers answered that discomfort/pain is related to the current work sector. The ratio of workers who believe that pain is directly related to the work sector is shown in Figure 6.

Regarding the "region of discomfort", the great majority of the workers presented discomfort and pain in three regions, the spine, shoulder, and legs according to Figure 7.



**FIGURE 6:** Percentage of the workers who associate the discomfort with the work sector.

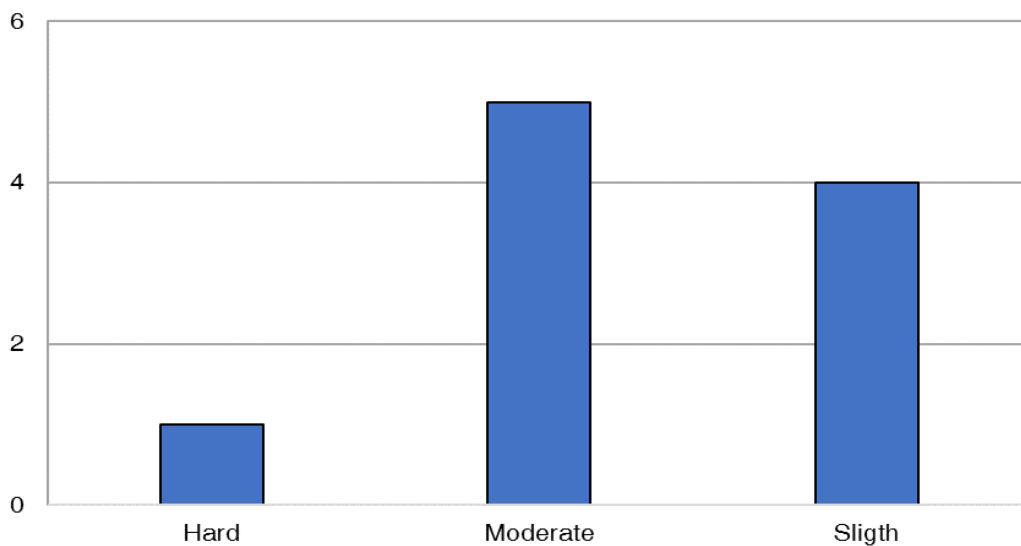


**FIGURE 7:** Region of The Body with Incidence of Pain.

Finally, concerning “intensity of discomfort/pain”, most of the respondents felt a moderate or a slight discomfort/pain, with the exception of a worker who was in severe pain during the interview (Figure. 8).

Based on the present combined qualitative and quantitative approach together with the descriptive analysis, measures will be proposed to improve the ergonomic aspects of cooperative work, aiming at a reduction of the discomfort, pain, and health problems due to the ergonomic posture adopted during work hours.

Examples of these measures include the creation of break times during the day for rest and hydration, the implementation of gymnastics at work, and the adaptation of mats and movers for the transportation and movement of materials. These measures will probably be well received by the cooperative workers in view of the lack of adequacy of the activity throughout the productive process.



**FIGURE 8:** Pain intensity.

Finally, an ergonomic improvement aimed at increasing productivity and the well-being of the workers, further reflecting on the cooperative's financial gains, is expected to be achieved after this study.

#### **4. CONCLUSIONS**

This study shows that application of ergonomic concepts allows establishing a correlation between the injuries and problems in the workplace of a cooperative of recyclable materials. This is because the interference of a subject changes directly the context and efficiency of the other.

Each cooperative worker is primarily responsible for itself and the way it operates. However, this impacts on the overall productivity of the cooperative. Thus, every cooperative worker is asked to produce satisfactorily in compliance with acceptable standards. This will not hamper total productivity, adding value to the organization's members, controlling operations, fostering well-being, and the personal and group satisfaction within the organization.

Through this study, it is possible to understand the lack of understanding on the need to protect health and to work under acceptable ergonomic standards, preserving physical integrity, avoiding accidents, and exposition to risk situations. Ergonomics is neglected, precarious, practically ignored, and the tasks are developed in a totally artisan way, adapting man to work without considering the health aspects of the cooperative workers.

The culture of self-preservation and zeal for productivity within the workplace is lacking, given the scarcity of resources and the inadequate working conditions present in this activity sector.

The reality of the cooperative members is challenging, causing workers to worry about several issues such as the type of materials handled, work hours, labors, productivity, and remuneration. However, there is room for improvements, provided the need to exercise heavy labors is overcome by the will to rethink processes to solve difficulties and apply improvements in the daily life of the cooperative. Ergonomics in the sector of recyclable materials cooperatives is a fundamental tool for the recovery of workers' dignity, preservation of health, and the achievement of ideal productivity. As future work will be proposed new evaluations using computational tools aiming to establish the link between the qualitative and quantitative evaluation.

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