

Quantitative analysis of repetitive movement as a tool for diagnostic support in ergonomics

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Abstract. Objective: To evaluate muscular strain in the upper limbs of workers in a freeze-processing plant for poultry by developing a tool for quantitative analysis, yielding a final score, which can provide diagnostic support in legal proceedings. Methods: The Strain index proposed by Moore & Garg was used to quantify biomechanical aspects of muscular strain, evaluating the intensity and duration of effort, frequency of movement, position of wrist and hand, speed of activity and duration of the task per shift. The index was applied in three critical work-areas in a freeze-processing plant for poultry where the activities of nine workers were analyzed. Results: Absenteeism caused by osteomuscular lesions and mental-health problems reaches 20%. The three work-areas studied are those where the birds' throats are cut, where they are suspended on a conveyor-belt and, where they are wrapped. These areas were chosen because they have the highest rates of absenteeism and rotation of workers. The findings identified final scores between 12 and 27, when 7 or more means the maximum risk. Conclusion: Defensive strategies developed by workers can reduce biomechanical problems arising from high throughput rates, but are not enough by themselves to allow production to proceed without the occurrence of osteomuscular problems.

Keywords: biomechanics, cumulative trauma disorders, ergonomics, work in freeze-processing plants.

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1. Introduction

This article discusses the need to use a specific tool to quantify the muscular strain in repetitive muscle movements performed by workers of a freeze-processing plant. From a lawsuit, it was sought to identify quantitative data to allow the federal judge to know the intensity of repetitiveness the workers were subjected. There are indications the judges do not receive this information clearly in expert reports of ergonomic analysis of work. In audits for judicial process purposes, there is the need to quantify the risks, and, in cases of repetitive work, the use of Strain Index tool proposed by Moore & Garg [5] has proved to be important for the identification and quantification of the severity of the existing work situation.

The analyzed company deals with the slaughter and processing of approximately 450 thousand poultries per day. Approximately 2,200 employees work at the company (industrial and agribusiness area), 1,300 of these workers at the freeze-processing plant, including the employees of administrative, commercial and development.

Between 93 to 95 % of the production is turned to the Muslim market, determining that the poultry is sold whole. The others 5 to 7 % are processed in defined cuts.

The demand has come from complaints of the Labor Union related to the high incidence of absence due to diseases related to work and the occurrence of fatal accidents at work in the unit. It has also been identified a long history of notifications made by Labor Inspectors in the field of health and safety (in Brazil called Labor Auditor Fiscal). At least 69 inspections had already been done in the plant. Another demand has come from the Federal Office of the Attorney General of the National Institute of Social Security – INSS – requesting information on the work conditions in freeze-processing plants, due to the significant number of absences with social security benefit for diseases resulting from this industrial sector in Southern Brazil. These facts have resulted in a series of inspections aiming at the recognition of the safety conditions, the operational mode of the organization, the compliance to the safety rules, personnel management, the objective and subjective aspects about the health and safety conditions of the workers.

The management of the company recognized that the illness of the work was a serious problem and that the turn-over in various sectors was another troubling fact. There were expressions of interest from the top

management of the company to investigate the motivations of these absences and the relation to the conditions of work. An important step in this direction were the changes in the area of Work Safety with the hiring of more qualified personnel to perform precise diagnoses leading to concrete actions and changes in intervention projects.

The middle management has not seemed to recognize the process and work organizations were factors that negatively affect the development of the productive factor.

The workforce has clearly reported that the pace of production is strong; the personnel management does not allow their complaints come to the decision centers of the company and that the allocation of workers in “harder” posts does not correspond to what they think about the number of workers in these posts.

This factory specialized in the production for the export market to Muslim countries. This definition combines the specialization and the experts’ definitions of production spaces creating and maintaining closer ties with the market served by the business group. In this case, the specialization of the production process in this business is strongly influenced by religious guidelines, both in the slaughtering and the production process itself. For example, the plant meets the positioning demands of the slaughtering process in relation to the holy city for these consumers, as well as rituals during the slaughter followed by religious auditors appointed by the purchasers. Thus, the plant has specialized in the production of whole poultry (whole carcass), standard size, although smaller in size (for individual consumption of each carcass).

The production process is strongly integrated with the entire production chain. The company controls from the purchase of matrices in the North-American market (the so-called chicken grandparents), the production of laying hens, eggs, chicks production and raising to slaughter. This whole production chain gets the attention of the company, with specialized planning and follow-up areas with experts in zootechnics, agronomy, veterinary, including logistics of feeding, production and animals’ movement in all phases of the process, all of them with online tracking by computer systems. The poultry production is developed in a process of farms (about 2,700) integrated with the company, involving logistics of chicks, food, feed, medication, and poultry collection distribution. In this process, each farm is visited by technicians of the company (3 visits per production lot, on average). Each 50 breeders are accompanied by at least one

technician, who is supervised by veterinarians. The eggs are incubated for 21 days and chicks are killed in this plant, between 27 days (males) and 32 days (females), when they reach the recommended weight. At least, twice a week coordination meetings are held between development, production and commercialization.

The production for foreign trade is referred as easier, with longer-term orders, allowing more planning and less wear on the process management. For the domestic market, sales are often made in the short term, with tighter adjustments and time-management process.

2. Material and methods

Eleven technical visits were made to the plant. Audiovisual recording were used (Camera - Sony DSC-W 180 Cyber Shot 10.1 Mega Pixels and Camcorder Sony DCR-HC40 NTSC); interviews with workers and managers; direct observation of jobs (free and systematized); analysis of documents; analysis of 69 records of previous inspections developed by labor inspectors; ergonomic analysis of the work developed in four areas; and repeatability measurement in three areas.

The findings of the interviews were correlated with the data provided and the reports provided by the company.

After the interviews with some managers and workers, and from the general observation of the first inspection, it was decided that the analysis should focus on situations containing elements evidencing biomechanical and psychological strain workers had referred to as the most serious. For quantitative analysis, it was chosen the area where poultries were killed by cutting the throats, where they were suspended on a conveyor-belt and where they were wrapped, because these are the most critical sectors according to the workers and the data of removal from the company (higher absenteeism and labor turnover). In Ergonomics, it is asked: why does this or that area "eject" more workers than others? In this company, packaging is responsible for almost half of admissions and dismissals of the whole plant.

For the quantification of repeatability measurement and Biomechanical Aspects of muscle strain occurring at these three critical sectors, it was applied the Strain Index posture protocol proposed by Moore & Garg [5]. This tool enables not only the risk quantification in upper limbs by functional overload, but also improvement simulations at work and adequacy of jobs. The protocol evaluates the

strength intensity, duration of effort, frequency of movement, wrist and hand posture, work speed and duration of the task per shift. The index was applied in the analysis of the activities developed by seven different workers.

3. Results

It was verified that 596 out of the 1 225 workers of the company are between 18 and 30 years old, 244 workers between 30 and 40 and 224, between 40 and 50, respectively. It is evident that almost the half of the workforce is formed by the youngest workers. The data provided by the company does not make explicit the ages according to the job or work place.

In average, absenteeism at the plant is higher than 5 %. In other words, every working day 20 workers are absent from work. Data provided by the company didn't have quality enough to identify the situations of greater risk, since the figures provided do not identify absenteeism by sector, position, function, age or working time in the plant, for example.

Turnover was between 3 to 5 % per month, decreasing considerably in 2009. The company didn't inform which the policy responsible for this decrease was. Labor replacement is not equal throughout the plant. As there are sectors with a much lower turnover in comparison to the plant as a whole, such as cleaning, chiller and bleeding, and there are other sectors presenting strong turnover such as packaging and evisceration. Also, there isn't information on turnover by age or length of service in the plant, which also raises difficulties as to the analysis of these data in terms of our interest in ergonomic diagnosis.

In this company, 20 % of the workers are out of work on social security benefits, most of them due to osteomuscular lesions and mental-health problems.

The production process is developed in three shifts from Monday to Saturday. Production is programmed for 22,750 young chickens per hour, 11,375 young chickens per each noria. Birds arrive for slaughter weighing between 1,290 to 1350 g., alive, reaching an average between 1,000 g. to 1,050 g. per piece packaged. Each package must weigh between 800 to 1200 g. The production sector receives a slaughter forecast, with the average weight defined by the purchaser. The operator performs the programming and the packages should go to that specific purchaser with a variation of up to 50 g.

Both workers and managers in charge stated that the worst situation in the production sector is when equipment breaks, leading to production stoppage. Such incidents occur quite frequently, sometimes daily.

Working conditions

We establish two lines of analysis on the conditions of safety and aggressors of the workers' health in the inspected plant: 1) analysis of the environmental conditions of work objectively recorded; and 2) analysis of the organization itself. For this analysis we used Ergonomics tools, but basically we aimed at understanding the perception of workers by listening to their common speech, observing the existing personal relations, the underlying processes of maintenance and control over workers, the growing demands of production in the sector and the possible consequences on the workers' health and safety.

Environmental agents

Cold: below 12 degrees in the production sector and below zero degrees in the cold chambers.

Noise: as to the physical agent "noise", it should be taken into account that in cold storage plants, the environment Works often present high levels of noise. This risk is harmful to health, also generating additional pay for insalubrity. There is description of activities and operations with various noise measurements above the tolerance limits permitted by law. According to the noise exposure surveys developed by the company and present in its PPRA (Program of Environmental Risks Prevention, the presence of noise above the action level and at various locations above the limits of tolerance is almost a constant in the company's production areas. This risk is present at the following work places: 1) platform, 2) bleeding, 3) scalding, 4) evisceration, 5) chiller, 6) giblets room, 7) federal inspection, 8) cutting room, 9) packaging, 10) packaging preparation, 11) tunnels, 12) dispatch, 13) by-products, 14) cleaning, 15) quality control, 16) maintenance, 17) boiler 18) management, 19) warehouse, and 20) distribution center.

In addition, for many years, the company had the prorogation of work journey in this harmful activity, increasing the occupational exposure. There is shortage of protective measures as to the sources of noise, and many measurements of environmental noise above the action level for noise (greater than 0.5).

Certificates of Occupational Health classify noise exposure as one of the specific occupational risks to which workers of packing plants are exposed. It was given hearing protection - personal protection devices - such as isolated protection for the workers exposed to high levels of noise, in detriment to collective protection. This kind of system may have limitations as to noise reduction, because there are four paths of leaking through the protector:

- a) transmission through bones and human tissue;
- b) vibrations of the protector ;
- c) transmission through the materials of the hearing protector; and
- d) leakage through the contact of the protector and head.

Humidity: The Company itself knows about this agent, since in the survey of environmental risks it is present at the following work places: 1) platform, 2) bleeding, 3) stairs, 4) evisceration, 5) chiller, 6) giblets room, 7) federal inspection, 8) cutting room, 9) packaging, 10) tunnels, 11) cleaning, 12) control of quality, and 13) hydraulic maintenance.

As to the cleaning process, it is verified that there is an accumulation of viscera, glands, blood, bones and excrement in different sectors of the company. The presence of these factors exposes workers to various biological and chemical hazards. Because of this accumulation there is also an unpleasant odor in these work areas. Because of the humidity and the visceral fat and parts of the animals that fall down, there are risks of falls due to slipping.

Characteristics of productive organization

The activities developed in this plant are segmented, based on the traditional Taylorist/Fordist and are subjected to the rhythm imposed by the conveyor belts and machinery, according to the production, time and quality guidelines stipulated by the management. In this process, it was verified that the workers do not have any kind of control as to the activities developed, being impossible to decide on the rhythm and mode of execution. In this sense, the adjustment of the rhythm and mode of operation by the worker, according to his individual characteristics, is almost zero, a fact which imposes a large gap between the autonomy of the worker and the objectivity of production parameters.

The activities in the analyzed sectors are quite consistent, with very short cycles of work

and high repeatability. In fact, these activities are monotonous, featured by the accumulation of repetitive operations and extreme limitation of communication among workers, for at least two reasons:

- 1) due to the very notion of Taylorist/Fordist organization model imposing a segmentation at all levels, including the subjective level [4];
- 2) their own environmental conditions: excessive noise and use of auricular protectors.

After interviews with some managers and workers, and from general observation of the first inspection, it was decided that the analysis should focus on situations containing elements demonstrating the biomechanical and psychological overload the workers had referred to as the main ones. Then, the situations which were defined to be analyzed were:

1. poultry slaughtering ;
2. carcass re-hanging; and
3. packaging closing.

From these definitions, we returned to the company for new general observation and interviewed the workers operating in these posts. During the observation, it was possible the data collection in different situations of staff jobs composition in their posts, including periods of personnel change, shift change, knife sharpening among others, everything in order to safeguard the situations and the productive process of the company should be fairly analyzed.

Poultry slaughtering –bleeding

The jobs at the bleeding line are organized according to the requirements of the Islamic importers, requiring the manual slaughtering of the animal, with the workers positioned towards a certain cardinal point. The cutting operation should also be unique, made at once, also due to a requirement of the importer, for reasons unknown. The bleeding activity is performed with the animal still alive, due to the company's commitment to the importer, who, for religious reasons, determines procedures of poultry slaughtering. This has to be with a knife in a single blow, on the neck of the bird. In average, 320 birds are slaughtered per minute, or 1,670 birds/minute in each of the two norias, or approximately 40 (forty) birds for each of the four workers who are at slaughter. The production is scheduled to 22,750 chickens per hour, 11,375 chickens for each noria. After one hour in the activity, the workers leave the slaughtering line and go to the special room for a special pray, within the requirements of the production buyers.

The stunning process consists of an electrical discharge in the humidified head, to make the manual slaughtering process easier, so that the animal does not have any movement when being cut. After, the chickens are subjected to a manual cut in the neck and to the bleeding process, during which they remain in blood dripping for a period of approximately 3 minutes.

In interviews with workers in this sector, they reported that the pace of work there was intense, and complained about the insufficient number of people to maintain the production flow required by the company. They also declared that the bleeding operation requires a careful handling of knives, which must be sharpened very often. In this process, cutting accidents occur, and the vast majority of them would not be registered as accidents at work.

The workers report that the most wearisome situations, besides the process itself, is when one of the workers has to leave production of sharpen knives, and when one of the workers who is at the slaughtering sector is inexperienced, and is not part of the team. The workers also report that having three workers at the bleeding sector is a very stressful situation, being this situation very frequent. When there are four workers, they say it is less stressful.

The workers report that the process of sharpening knives is extremely important, even if the time he gets out of the line he overloads the others, but it is the sharpened knife that reduces the effort to kill the bird.

In this operation, there is the claim that the environment is too hot and that the fan is not enough to produce cooling. In the summer, the situation is referred as very stressful, because of the heat from the roof (which would be made of zinc), provoking discomfort among the workers.

One of the problems referred in this activity is that the bird cannot be killed before being cut but it cannot be too vivacious not to hinder the process. Thus, before the slaughtering, the bird is watered and suffers an electric discharge, making it inactive, but alive. Often this electric shock, due to problems of maintenance and material wearing, is insufficient to cause the trope and the birds arrive at the slaughtering sector awaken, and moving, making the worker more stressed, with higher risks of injuries including dropping the knife, delaying all the process and requiring that the worker "run" after the noria to recover the seconds lost. All the workers have scars from cuts in the upper limbs and sometimes in the lower ones.

Another frequent complaint is about the water fountain that heats during the day, leading to the need to get ice to cool it. Thus, one of the workers has to abandon the sector, overloading the others.

In the bleeding sector we verified the following important environmental factors: 1) exposure to the animal blood, and the respective biological risk; 2) unpleasant odor; 3) thermal discomfort; 4) absence of effective ventilation system; 5) intense rhythm of work (discussed more quantitatively in the Ergonomics Analysis of the work); 6) no use of IPEs by all the workers; 7) risk of frequent cuttings; 8) inadequate ventilation.

We reiterate that the respondents of the sector reported that the number of workers in this sector is insufficient to the requirements of production imposed by the company.

Transcription of one of the interviews:

“When I came back of the toilet I noticed that the knife wasn’t sharpened to cut the neck, and when I was sharpening it my colleague Re called me and I went to her sector to know what she wanted. When I looked forward, my manager told me to go to the small room, pass the name pad and go out because I was suspended. He said that when I was downstairs I abandoned the sector; if they did the right thing in the area of work, 4 workers in each sector and not 2. There are 4 workers only when Dr. Veterinarian comes or the manager visits the sector, or something like that, visitors, for example, or some important people, then area of work is complete, the workers can’t have knives in their hands, they have to store them, pretending we work correctly, as the “big boss wants”.

Re-hanging

After the carcasses had passed by the automatic process of defeathering, they passed by a cooling process, from which all the productive process will occur. The product needs to be cooled because of sanitary safety. After cooling, the carcass is placed into the noria again, and suspended by the feet. In this activity, the workers pick the carcasses up by the body, from a metallic channel where they are placed automatically and are hung by the legs on the hooks. In this activity, each operator puts one carcass in a certain space of the noria, so as to allow the worker beside has room to hang other carcasses side by side. That moment, the two slaughtering norias are consolidated into one.

Packaging

In this sector, it is possible to alternate the eleven or twelve positions. The rhythm is faster in the first positions and decreases as the post is farther from the beginning. Each operator wraps one chicken in each box having room for ten chickens passing by his side on the conveyor. The last worker on the conveyor has to “arranging” the content in the boxes and, when necessary, sealing the chicken again. The workers have reported that it is better to work “in advance”. This way, they wouldn’t need to “twist” the body too much. It is tiresome when the sealer doesn’t seal and the worker has to repeat the process, “to seal again”, making him “run after” the box. The activity is influenced by the fat that sits on the tape. It depends on the size of the chicken: the bigger the size, the greater the quantity of fat, the greater the difficulty with the sealing tape. Each worker seals approximately 9 chickens per minute. Each box has ten or twelve chickens, depending on the type of box previously defined. Most boxes contain ten chickens.

It was identified the inadequacy of the physical spaces of the working areas, mainly the packaging sector, as described below. It was observed that the dimensions are extremely exiguous, blocking the free movement, forcing the workers to develop their activities in a diagonal position, being in permanent physical contact throughout the workday. The workers reported the fact bluntly and recursively.

For the present case, we built the following pre-diagnosis, which directed our line of research in the work places: development of osteomuscular pains among the workers is caused at least by two conditions:

- a) the production process is “hard” because it is required the production of a fixed number of slaughtered and frozen birds, ready to be delivered to the consumer market;
- b) the spaces of individual and collective regulation are minimal, not allowing the workers to be able to recover their normal state and physiological rest.

3.1. Quantitative results of repeatability

The findings have identified the index values between 12 and 27, when the maximum value defined by the proponents is 7. These different indices can be explained by the different responses given by the workers to the same pace degree and pressure for production by the middle and upper management.

Bird Slaughtering – bleeding

The worker stands still in front of the conveyor, where the chickens pass by, hung upside down. The worker holds the head of the chicken and the right hand makes a cut in the animal's neck. Four people work side by side in the same post, cutting the necks of chickens.

The activities were analyzed with two different compositions of the workers team at the same area: Composition A (four operators present) and Composition B (three operators present). This is a frequent composition, when it is necessary both to sharpen the knives and go to the toilet, to the ambulatory or the human resources department, among other possibilities. In Composition A (four operators at the post) each worker has performed 37 complete cycles of birds slaughtering with a cut in their necks. In Composition B (three operators at the post) each worker has performed 53 cuttings per minute, that is, 43% more movements than it is done when there are four workers at the conveyor. The work of the second operator was analyzed at the Composition B, when he can perform 61 cuttings per minute.

In this activity, the main biomechanical overloads are in the lumbar region, by standing up for long periods during the whole journey, and overload of upper limbs, from the shoulder to hands, by the shoulder flexion, wrist deviations and repetitive movements.

Summary of Analyzes:

Posture Protocol – Strain Index [2, 5]

- a) Task: To cut the neck of chickens (Worker 1 – Composition A); score 12.0;
- b) Task: To cut the neck of chickens (Worker 1 – Composition B); score 18.0;
- c) Task: To cut the neck of chickens (Worker 2 – Composition B): score 27.0.

Re-hanging of chickens on the conveyor

The workers stay still before a channel-shaped bench where the chickens are. Noria passes right above the bench, in front of the workers. The workers take the chickens from the bench (one in each hand at the same time) and re-hang the chicken on the conveyor (1 in each hand at the same time or one hand at a time). It was followed and detailed a one-minute shooting of the workers, called Worker 3 and Worker 4. Both workers hung an average of 48 chickens per minute.

In this activity, the main biomechanical overloads are in the lumbar region, by standing up for long periods (during the whole journey) and overload of upper limbs, from the shoulder to hands, by the shoulder flexion, extreme

movements of wrist as supination and deviations as well as repetitive movements.

Summary of Analyzes:

Posture Protocol – Strain Index [2, 5]

- a) Task: To hang chickens on the conveyor (Worker 3); score 27.0;
- b) Task: To hang chickens on the conveyor (Worker 4): score 18;

Packaging Closing

The workers stand still, sideways to the conveyor and facing the bench. The chickens pass by the conveyor, in the packaging boxes, that are open. The workers are positioned one behind the other, pick up the chickens from the boxes, perform a turning maneuver to wrap the top of the box and then they cut the excess of plastic. It was followed and detailed a one-minute shooting from each of the three of the workers, in this area. The workers at the beginning of the conveyor close the packaging boxes faster than the ones at the end of the conveyor. The workers positioned at the end of the conveyor check the boxes to see if all the boxes are closed, and when they see some non-standard, they pick it up and close it, placing it on the conveyor in the same box. In this activity, the main biomechanical overloads are in the lumbar region, by standing up for long periods (the whole journey) and by the need for bending and rotation of the column to pick and place packaging on the conveyor. It also occurs an important overload of upper limbs, mainly due to extreme movements of wrist, such as supination and deviations as well as repetitive movements.

Summary of Analyzes:

Posture Protocol – Strain Index [2, 5]

- a) Task: to close packaging and put the wrapped chickens into the boxes (Workers 5, 6 and 7): score 36.0;

Summary of the Measured Values of the Indices:

- a) Task: Slaughtering of birds by a cut in the throat
 - i. (Worker 1 – Composition A): Index 12
 - ii. (Worker 1 – Composition B): Index 18
 - iii. (Worker 2 – Composition B): Index: 27
- b) Task: Re-hanging of chickens on the conveyor
 - Task: Re-hanging of chickens on the conveyor
 - i. (Worker 3): Index 27
 - ii. (Worker 4): Index 18
 - c) Task: To close the packaging
 - i. (Workers 5, 6 and 7): score 36.0;

Final Considerations analysis using the strain index protocol:

As mentioned before, and in order to allow a quantitative assessment and to make easier for the magistrate to recognize with more security the risk situations, we are in favor of using a tool that would enable such quantification. The observation and analysis of the work have been already obvious as to the hard rhythm of the tasks of these workers, leading them to assume very high risks, but for the purposes of determining the severity and future monitoring, it is important to use tools that quantify this rhythm. In the analysis, this protocol has resulted in high risk for the four jobs of this company that were analyzed.

It is important to highlight that the analyzed activities are performed in the orthostatic position and, most of the time, the workers maintain their cervical region flexed, performing repetitive movements with upper limbs.

4. Conclusion

It is very clear that the way the tasks are performed; they overload the osteomuscular structures of the upper limbs. The “Moore & Garg Index” has allowed quantifying different biomechanical aspects of the operations performed by these workers. The repeatability, the strength of apprehension, the angles the body segments assume to perform the manual tasks are well explained, and the tools allows both the comparisons using the standard scale proposed by the authors and comparisons among different post, or, even comparisons in the same post with different compositions in the same area with different compositions of groups of workers. This was one of the most positive aspects identified by the legal operators who had access to the final report, because, from that moment, they had a report with quantitative data which could be understood by a layman in Ergonomics, allowing an evaluation of the existing risk. This understanding has allowed an easier nexus relationship between the working conditions, work organization and illness among workers, especially in cases of osteomuscular pain.

The tool has allowed to show that even when the intensity of the effort is low, the duration of the efforts tends to persist for long periods, during the entire workday, with permanent and continued repetitions (repetitive efforts), with high-speed activities execution, as referred above, throughout the day. When there is employee turnover, it is accomplished in a way that it does not occur the resting of

the overloaded structures, because the worker will have to perform an equally repetitive task for the upper limbs.

It was verified that to the requirements of the Taylorist/Fordist work organization, new charges and distress are added, among them fear of not being able to correspond to the new standards that include aspects related to time, rhythm, speed, formation, information, learning, adaptation to the culture and ideology of the company, which, in turn, claim to follow the market requirements [1, 4]. There is, in fact, an overlapping of old and new models in their most aggressive aspects such as time control, quality standard, and pressure for production, without the benefits each model offer, such as greater participation of workers in decision-making process and increased communication between management and operational levels.

About the time control, for example, it was verified that one of the ways such control is exercised by the company is the subtraction of basic rights of the worker, such as going to the bathroom when necessary. This fact shows that control and vigilance operate on different levels and they are not limited to the requirements of productivity, time and quality, but also to the most basic levels such as the physiological ones [3].

The defensive strategies promoted by the workers can reduce the biomechanical constraints coming from the excessive rhythm of production, but, at the rhythm imposed to the workers, they are insufficient to allow the production without these constraints lead to the emergence of osteomuscular injuries.

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