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Work conditions assessment in manufacturing organizations in the colombian caribbean region

Evaluación de las condiciones de trabajo en empresas manufactureras de la región Caribe colombiana

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ABSTRACT: Deficient work conditions have been linked with an epidemic of injury and illness in low and middle-income countries. A group of 22 companies from different sectors was selected in order to carry out a diagnosis related to work conditions in Colombia. To do so, an instrument was designed based on the International Labour Organization (ILO) standards. This information allowed identifying potential problems in work conditions such as work environments, physical load, noise and social welfare. Some low cost measures were discussed as suggestions to improve work conditions. Such measures are expected to generate both an increase in productivity and an enhancement in the employees' attitude.

RESUMEN: Las deficientes condiciones de trabajo se relacionan con enfermedades y lesiones en los países de bajos y medianos ingresos. Un grupo de 22 empresas de diferentes sectores fue seleccionado para realizar un diagnóstico de las condiciones de trabajo en Colombia. Con el fin de hacerlo, se diseñó un instrumento basado en los estándares de la Organización Internacional del Trabajo (OIT). La información recopilada permitió identificar problemas potenciales relacionados con las condiciones de trabajo, tales como: condiciones climáticas, esfuerzo físico, ruido y bienestar social. Algunas de estas medidas de bajo costo fueron discutidas para mejorar las condiciones de trabajo, esperando que tales medidas generen un incremento de la productividad y en la actitud de los empleados.

1. Introduction

Work conditions are related to injury and disease processes in workers, which could be detrimental to the productivity and quality of work life across industries [1]. However, in most manufacturing industries, particularly in low and middle income countries, there is a lack of understanding of the impact of work conditions [2]. Managing work conditions is not a trivial task considering the various and complex factors that can have an effect on the worker. Despite its complexity, the consequences of not managing work conditions effectively are: (a) large increases in economic and (b) social costs that will affect the sustainability of a business [3]. For instance, it is known that mentally and/or physically exhausted workers typically have both a poor quality work performance and a larger rate of absenteeism, as a consequence of inappropriate work conditions. This absenteeism will consequently interrupt the normal flow of work, resulting in a decrease in productivity [4, 5]. Therefore, companies have the responsibility to ensure the safety and well-being of their workers, not only to increase productivity and reduce negative health outcomes, but also to protect their competitive advantage [6].

It is estimated that 2.3 million workers die every year due to work related illnesses or injuries [7]. The harms produced by deficient work conditions depend on the type of activity that is being carried by the worker. For example: (a) the production of pesticides or chemicals might expose workers to lethal substances; (b) an individual working in a bank can suffer from mental stress; and (c) an employee in the construction of skyscrapers is exposed to risk of severe injury or death. In the case of Colombia and Latin America (except for Brazil), there is a lack of statistics related to occupational health [8]. Nevertheless, the limited amount of consolidated information in possession and the estimations in Latin America show that the effects of occupational diseases are extensive with a tendency of growth [8].

In Colombia, majority of workers are not aware that their employer must provide adequate work conditions and neither companies or the government, have comprehensive policies or legislation related to this issue [3]. Similarly, companies and professionals that are able to take some initiative to improve work conditions lack the basic

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understanding of ergonomics and job [2, 9, 10]. Economic and socio-political pressures force workers to accept a job even if the work conditions provided are inadequate. Moreover, any requests for improvement in work conditions may potentially cause retaliation from the employer (e.g. dismissal or bullying). Therefore, given the large risk of these potential consequences, demands or complaints about work conditions are virtually inexistent [4].

The International Labour Organization (ILO) offers experience and knowledge related to work design and occupational health management on an international scale. The studies conducted by ILO show that simple countermeasures can improve considerably the work environment and, that opposite to common belief, some of such measures are cheap and easy to implement. ILO has developed standards related to work conditions, the implementation of occupational health programs, and management of work risks. These standards are considered as long-term mandatory targets for most industries worldwide.

This research seeks to make an assessment of work conditions in Colombia in order to: (a) support targeted countermeasures and (b) allocate resources to reduce the epidemic of work related illnesses or injuries. This research uses ILO standards to develop an instrument to diagnose where local companies stand in terms of work conditions as well as establishing a benchmark for an assessment among them. The instrument is used to collect information, identify the major weaknesses and strengths regarding occupational health, and discuss solutions to be implemented in order to improve working conditions. Finally, this information may contribute to the design of public policy and training programmes on occupational health.

2. Methodology

2.1. Sample

The companies included in this study all belong to the manufacturing sector: production of plastic pieces and bags (30%); textiles (30%); metal-mechanics industry such as cans and construction appliances (20%); metallic furniture (12%); and production of organic charcoal and chemicals (8%). This group of companies reflects the economic activity within the Colombian Caribbean region. One aspect common to all companies is that they are all small to medium Enterprises (SMEs), in which it is expected to find bigger problems related to work conditions than in large companies. Small and medium enterprises (SMEs) are different from large organizations, because these are reactive and have reactionary mentality, resource limitations, informal strategies, and flexible structures. These organizations count with at least 15 employees between operators and administrative personal. The sample size (22 enterprises) was selected considering a study by Walker and Tait [11], in which the impact of the implementation of a health and safety policy risk assessment was measured.

2.2. Instrument and data collection

Creating a complete and comprehensive instrument required the use of the ILO's "introduction to work study" and the works of Frieling *et al*. [12] and Hayes *et al*. [13]. The instrument comprises seven major sections, each evaluating different components of the workstations studied [14] (see final instrument in appendix). Section one evaluated physical load at both dynamic and static conditions as these may cause back problems. Section two was related to the thermal environment and it analyzed if the temperature, clothing, ventilation, and protection were appropriate. The two following sections –three and four– studied noise and illumination as they can be sources of auditory problems and visual tiredness. Section five evaluated the mental load by considering aspects such as the complexity of the task and time pressure. The next section focused on psychosocial aspects of work through the assessment of the relationship between coworkers at both a peer level and managerial levels. Finally, section seven evaluated whether: (a) the working time was between human and legal standards, and (b) payment was fair (see Appendix for final instrument). The grading scale used in this study was developed using the ILO standards (Table 1).

Data was collected by groups of students who visited the companies via observation and interviewing the employees. Each item on the instrument was later graded. The companies' staffs were all notified prior to the visit so that every employee was informed that the presence of students was not a threat and that they should not feel nervous to answer questions sincerely since the idea was to capture information under a natural working environment.

Table 1 Grading criteria

Description	Score
The workstation accomplishes satisfactorily the standard/ Conditions are optimal	10 – 9
The workstation accomplishes the standard but some details have to be attended / Conditions are adequate	8 – 7
The workstation accomplishes partially the standard /Conditions must be improved	6 – 4
Urgent measures have to be implemented	1 – 3

Table 2 Work conditions scores: pooled total and by manufacturing sector

Components	Total	Plastic	Textile	Metal-mechanic	Organic
Physical load	4.9	4.6	5.7	5.2	6.2
Thermal environment	5.7	4.4	6.5	5.5	6
Noise	6.3	5	7.1	6.1	6.6
Lighting	7.8	6	8.1	7.1	7.6
Mental load	6.8	4.5	7.6	6.1	9.1
Psychosocial aspects of work	7.7	6.4	8.5	7.5	8
Time requirements	8.3	7	9.1	8.1	8.6
Total	**6.7**	**5.4**	**7.5**	**6.5**	**7.4**

3. Results

Work conditions scores per company were averaged and showed in Table 2. The lower average scores, which represent the worst performance, were reported in the physical load (4.9) and thermal environment (5.7) components. These were the most urgent aspects requiring improvement in the studied companies. The time requirements component was the best performing factor (8.3). The Plastic sector showed the lowest overall scores among the industries analyzed (5.4), whereas the textile sector was the best performing (7.5).

3.1. Physical load

The average grade obtained shows that despite partially accomplishing the standard, conditions must be improved. Eight out of 22 companies evidenced problems regarding physical load, with about half of them specifically dynamic load and the other half static load. More than half of the companies did not evidence problems with physical load requiring improvement. This indicates that the global grade obtained for physical load (4.9) may not accurately reflect the physical load work condition deficiencies given that some companies performed poorly whilst others showed no problems at all. So, an item analysis is recommended to make a proper analysis. Companies that performed badly on dynamic load are those that manufacture metallic pieces of furniture and plastic pieces, whilst those that performed badly on static charge were the ones that make clothing and manufacture plastic pieces.

Bad performance on dynamic load implies that workers have to carry heavy elements through long distances with no proper equipment or protection. This can be expected of companies that manufacture metal-mechanic pieces of furniture because products can be large and have to be carried from storage to production and moved from station to station. Since the companies are SMEs, it is not expected that they have advanced equipment for transporting elements. The plastic companies also have this problem mainly because plastic, despite being lightweight, large volumes of it (raw material) have to be added to the machines, in this case manually. The repetition of loading-unloading cycles may cause some hazardous effects to the employee, such as inflammation and degeneration of tendons [15]. As for static load, companies that manufacture clothing have their employees sitting on sewing machines for the entire shift, which typically generates discomfort and fatigue. Plus, plastic companies that showed problems on this subject also have their employees working on the same machine for the entire shift. In these cases where the operative has to be in the same spot for long times, it is desirable that the position and posture are comfortable. Unfortunately, it was the case in these companies. It has been shown that tasks that involve being in prolonged static postures may influence on the development of musculoskeletal disorders [16].

The simplest approach to reduce the impact of lifting heavy loads is by providing cargo belts and educating employees on the proper techniques for lifting heavy elements. Another viable option is to provide push karts [17]. These measures, while reducing the exposure to biomechanical load, will reduce the appearance of musculoskeletal disorders [15]. Whilst the only real way to eliminate the appearance of musculoskeletal disorders is by eliminating manual lifting, this is only possible with an extremely advanced layout or with the use of forklifts, which for SMEs in a local context is not always feasible. As for employees who have to be seated all day or have to be in the same spot, a reliable measure is to teach them proper postures that help avoid back pain and providing them adjustable chairs with an ergonomic design which reduces musculoskeletal disorder risk [10].

3.2. Thermal environment

Nine of the 22 companies presented problems regarding climatic conditions given that workstations had a temperature that was too high, ventilation was inappropriate and humidity was elevated. Overall this was the lowest score in among all the factors assessed in this study. The companies that presented most of the problems were usually those that manufacture plastic pieces, and clothing. Also, the metal-mechanics company, the charcoal company, and one of the companies working with aluminum all presented deficiencies. It is relevant to establish that the geographic location of the area in which the companies are positioned has an important effect on the environment inside the workspace. The city in which the study was conducted is located in the equatorial region

where no seasons are perceptible and both temperature and humidity levels are elevated throughout the whole year.

Equipment, people, and illumination are sources of heat that when added to a hot and humid climate can cause an inappropriate working environment. In the case of plastic and aluminum companies, machinery is expected to generate heat because in order to form pieces with specific shapes, the raw material must be melted. Dealing with such equipment requires employees to operate in close proximity to the high temperatures. As for the organic charcoal company, the production process itself requires high temperatures for material conversion; therefore, heat is not a variable that can be eliminated. In the case of the metal-mechanics and clothing companies, the machinery used does not generate a considerable amount of heat; therefore, most of the problems regarding the climatic conditions are related to poor ventilation and hydration.

Many measures are available to improve environmental conditions. The most obvious measure is installing an air conditioning system. However, such equipment is expensive and its operation cost is elevated given that electricity in the city has a high price. Also, installing such system requires that the production area must be completely closed to external air circulation, which can be dangerous because melting materials can release dangerous gases, which can produce respiratory diseases. Hence, it is preferable to improve ventilation systems with apertures to the exterior [18]. The best measures that can be taken are the aperture of windows in order to enable the ventilation of fresh air and the installation of hydration zones [19]. One aspect to consider is that many of the companies studied had closed production areas with no windows but had fans, which created some kind of relief, given that the same humid and hot air was being circulated, which is far from ideal. The aperture of windows not only enables ventilation but reduces the sensation of confinement.

3.3. Noise and lighting

In terms of/with respect to illumination, all companies performed well. Regarding noise, the situation was different. Noise obtained the second lowest grade among all the companies. The main reason of the obtained result was that one of the items in the instrument queries if the company provides methods to minimize annoying noise. In our sample, none of the companies provided such methods and, therefore, the grade assigned in such item was extremely low, which consequently reduced the overall score. This result is somehow expected in these companies where the occurrence of a sudden strong and dangerous sound is unlikely.

Only two companies presented significant problems with noise, both of which produce metallic pieces of furniture. This outcome is not surprising because the machinery that has to be employed in their productive process (e.g., saws and nail guns) produces loud and repetitive sounds. These two companies should provide protection to their employees by providing ear plugs. Reducing sound exposure is complex and potentially expensive. This requires seclusion, which implies either enclosing the machines in isolating chambers or buying new modern machinery with lower sound production [20]. One measure that can be effective is giving machinery continuous maintenance since its components may become loose over time.

3.4. Mental load

In general, mental load score showed that the standard was accomplished. This means that pause times are adequate and workers can leave their workstations. Also, the level of attention required is not too high and the amount of machines to be operated is adequate. In addition, the risk of accident if attention is lost is not too high. Only few companies presented problems with some items, especially the metallic furniture manufacturer because there are saws and nail guns, which can be highly risky despite being easy to manipulate them. One aspect worth noting when it comes to mental load within the work environment is that employees may become overconfident and start ignoring safety rules. The extent to which an employee perceives that he/she can ignore a safety rule has been defined by some specialists as a cavalier attitude. This cavalier attitude can originate both by the inherent state of the individual or by the organizational pressure to give more importance to production efficiency rather than safety [20]. It is recommendable for all companies that safety rules should be revised and displayed everywhere as well as that employers guarantee the employees the necessary resting time and sufficient freedom to keep their concentration levels high to prevent fatigue and decrease ergonomic related injuries and illnesses [7].

3.5. Psychosocial aspects of work

In this area, the companies' performance was very acceptable. Initially, none of the companies presented any deficiency in the relationships among staff members. This implies that, at the production area, the work environment is positive and, therefore, enhances the employees' performance. Small enterprises are considered to have a better psychosocial work environment than big ones, which may be due to closer relationships. Nevertheless, an item that did not perform as well was if the company itself boosts the creation of a good environment. The creation of a good environment is a consequence of the company's owner-manager style, and therefore the low sophistication and insufficient training of the managerial body in the SMEs in Colombia [21]. It was also noticeable that most of the companies allow their employees to be innovative in the way they work so that they can choose how to make their job as long as the quality and the production levels are fulfilled.

In the case of the relationship among employees and the management staff, the performance was impressively positive, with results close to ideal. Only one of the companies presented a bad relationship among employees and managers because, apparently, face to face communication was non-existent. The company presenting this problem was one that manufactures pieces of plastic.

As for quality monitoring, only one company presented an unfair procedure (also a company that produces plastic pieces). The fact that the only two companies that presented deficiencies in the psychosocial aspects of work (also happen to manufacture plastic pieces) may be construed as mere coincidence rather than a relationship between the core activity and such characteristics. The relationship between managers and employees is totally independent from the work task. Communication problems are often caused by the lack of interest of managers to have proper communication channels. It is relevant to mention that the overall good performance in this aspect may be explained by the fact that SMEs communication between the highest and lowest levels is relatively straightforward due to their simplistic hierarchy systems.

3.6. Time requirements

Time requirements evidenced good performance as: (a) most of the companies have shifts that comply with the law and (b) the remuneration is adequate for the time provided. The item with the worst performance was the pause times as some companies did not provide appropriate breaks. One of the companies in question was the same plastics company (section 3.5) that did not give autonomy to its employees to leave their station, which indicates that this company needed to change its policies to relax their expectations on workers. Aside from this, time requirements, in general, did not require immediate measures to be taken.

4. Conclusion

The investigation highlighted that the companies have both strengths and weakness in different topics of work conditions. Most of the strengths are associated with psychosocial aspects of work, illumination and time requirements. Conversely, the deficiencies found are related to climatic conditions, physical load, noise and social welfare programs. One characteristic that influenced these results was that the companies studied were SMEs and, therefore, their comparability to large enterprises is low.

The countermeasures suggested in this article can be easily implemented. Nonetheless, each specific company must consider which measures are suitable to its needs and will offer the highest benefit. The deficiencies found in this sample are not surprising given that they are caused by a lack of knowledge and concern regarding work conditions, which is also influenced by geographic location. It was too found that some problems are typically associated with the activity performed by the company. For example, employees who work with molten material (plastic, metal) are more exposed to high temperatures, which leads to highly inadequate workspaces. As for physical strain, any company that manipulates large amounts of raw material, irrespectively of its activity, will expose employees to lifting heavy elements, which possibly generates low back pain and musculoskeletal disorders.

The study also showed that the instrument used is a very powerful tool for benchmarking of work conditions and that it can be very easily applied across many industries. Evidently, this instrument only diagnoses the level of work conditions. The results derived from this instrument are useful for developing countermeasures and interventions. Ideally, the government should support the improvement of work conditions by offering funding and incentives to both employees and managers. It is important for managers to recognize the value of being concerned with occupational health rather than thinking that it is a mere obligation they must comply with in order to avoid problems with the law. A genuine conscience created towards work conditions will help to compete with more developed economies and bring more investment to national territory. Not meeting the international standards for work conditions will always represent a disadvantage when compared to industrialized countries. More importantly, it will expose the working class to risks that can be regrettable and preventable [22, 23].

Future research should focus on understanding potential uses of this instrument in the service industry, which is, in need, of larger productivity in low- and middle-income countries and remains under-represented in the scientific literature [24].

5. Appendix

Table 3 Final instrument

Component	Score
1. PHYSICAL LOAD	
1.1. Static Load	
The posture that is to be assumed by the worker doesn't generate immediate fatigue	
The worker has movement and space liberty to carry out his task	
1.2. Dynamic Load	
There is equipment that facilitates the carriage of heavy loads	
When carried manually, the loads are carried for short distances (<1.5 m)	
When load carriage is continuous, adequate break times are provided	
Workers are properly trained on load lifting in order to avoid injuries	
The usage of safety equipment and adequate load lifting are supervised	

2. CLIMATIC CONDITIONS
2.1. Without punctual sources of heat/cold:
Temperature throughout the area is considered comfortable
Equipment installed is adequate for proper ventilation/ air conditioning
Clothing is appropriate in relationship to the temperature (allows the maintenance of body temperature on 37 ^{o}C)
2.2. With punctual sources of heat/cold:
Equipment installed is adequate for proper ventilation/ air conditioning
Clothing is appropriate in relationship to the temperature (allows the maintenance of body temperature on 37 ^{o}C)
Proper hydration is given to the workers
There are no abrupt temperature changes
3. NOISE
There are continuous or variable sources of noise that force raising the voice
Sound generated in the area does not normally produce headaches or stress.
Sound generated in the area does not affect workers' attention or forces them to keep levels of concentration above those required by the job
If an annoying or stressing noise is generated there are methods to minimize it
4. LIGHTING
Illumination is concordant with the complexity of the tasks
Workers don't manifest visual fatigue at workstations
There are no glares at workstations
5. MENTAL LOAD
5.1. Time Pressure
Worker disposes of pause times during workday
Worker can absent his workstation without the need of being replaced
Payment doesn't depend upon units manufactured per unit time
5.2. Attention and Complexity
Workers can speak while carrying their tasks and this won't affect their attention
If distraction is generated during the task the risk of having an accident in minimum
The amount of machines or equipment that are operated by the worker is concordant with their capacity
6. PSYCHOSOCIAL ASPECTS
6.1. Interpersonal relationships/labor environment
Space and time for the communication and interrelation between workers are adequate
Work environment is adequate to carry out the activities
The company enhances the creation of good working relationships and comfortable working environment
6.2 Relationship with management level
Communication between employees and managers is fluid and adequate

The existence of respect between workers and managers enhances a proper working environment
The monitoring carried by the manager is fair and respectful
6.3. Initiative
The worker is free to innovate his work
Suggestions from workers are taken in to account to improve the quality of products and processes
6.4. Social Welfare
The company properly trains the employees so that these can carry out their tasks adequately
There is space for resting and recreation
The company is concerned about health and security for the operative
The company provides social welfare programs for their workers
7. WORKING TIME
Working load is adequate for performing the activities
Pauses and resting times are sufficient and contribute to avoid fatigue
Working shifts are adequate for performing the activities and are concordant with the law

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