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ERGONOMIC WORK ANALYSIS IN A CLOTHING INDUSTRY: A STUDY OF SEAMSTRESSES' TASKS

ANÁLISE ERGONÔMICA DO TRABALHO EM UMA FÁBRICA DE CONFECÇÃO: UM OLHAR SOBRE A ATIVIDADE DAS COSTUREIRAS

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ABSTRACT: Ergonomic Work Analysis (EWA) focuses on actual work, understanding the task within a specific context. The objective of this study was to conduct a workplace ergonomic analysis of workstations in a section of a garment factory, with the aim of identifying the structural elements that make up the processes at the workplace and assessing how these elements impact workers' health, safety, and productivity, in order to provide a foundation for proposing concrete organizational adjustments. The analysis covered both objective aspects, related to working conditions and work organization, and subjective aspects, integrating these dimensions with the workers' experiences, knowledge, and limitations. The methodology followed classical EWA, using a qualitative approach. Information was obtained through interviews and direct observations, and the data were analyzed using Content Analysis. The results pointed to difficulties related to work organization, as well as stress-inducing factors, such as rework resulting from corrections to garments returned by the quality control department. This process directly impacts individual production targets, leading to overload and dissatisfaction. Based on the workers' reports and the diagnosis, the main recommendations include: revising productivity targets to reflect operational variability; introducing scheduled breaks and job rotation to reduce biomechanical strain; and improving the material supply flow to minimize work interruptions. Furthermore, to address the organizational issues that lie beyond the operators' immediate control – such as the disconnection between quality control demands and production reality – the study suggests the creation of a protected "Work Activity Debate Space." This forum would allow seamstresses to collectively analyze their difficulties, confront viewpoints, and formulate viable proposals for management, while also gaining greater autonomy to implement local adjustments in their daily routines, thereby valuing their know-how, health, and well-being.

KEYWORDS: Ergonomic Work Analysis; Garment Factory; Participatory Ergonomics; Work Organization; Occupational Health.

RESUMO: A Análise Ergonômica do Trabalho (AET) tem como foco o trabalho real, compreendendo o fazer inserido em um contexto específico. O objetivo deste estudo foi realizar uma análise ergonômica dos postos de trabalho de um setor de uma fábrica de confecção, com o intuito de identificar os elementos estruturais que compõem os processos no lócus de trabalho e avaliar como esses elementos afetam a saúde, a segurança e a produtividade dos trabalhadores, a fim de fornecer uma base para propor ajustes organizacionais concretos. A análise abrangeu tanto os aspectos objetivos, relacionados às condições e à organização do trabalho, quanto os aspectos subjetivos, integrando essas dimensões às experiências, saberes e limitações das trabalhadoras. A metodologia seguiu a AET clássica, sob uma abordagem qualitativa. As informações foram obtidas por meio de entrevistas e observações diretas, e os dados foram analisados a partir da Análise de

Conteúdo. Os resultados apontaram dificuldades relacionadas à organização do trabalho, além de fatores geradores de estresse, como o retrabalho decorrente das correções de peças devolvidas pelo setor de qualidade. Esse processo impacta diretamente nas metas individuais de produção, gerando sobrecarga e insatisfação. Com base nos relatos dos trabalhadores e no diagnóstico, as principais recomendações incluem: revisar as metas de produtividade para refletir a variabilidade operacional; introduzir intervalos programados e rodízio de funções para reduzir a tensão biomecânica; e melhorar o fluxo de fornecimento de materiais para minimizar as interrupções no trabalho. Além disso, para abordar as questões organizacionais que estão além do controle imediato das operadoras – como a desconexão entre as exigências do controle de qualidade e a realidade da produção –, o estudo sugere a criação de um "Espaço de Debate sobre Atividades de Trabalho" protegido. Esse fórum permitiria que as costureiras analisassem coletivamente suas dificuldades, confrontassem pontos de vista e formulassem propostas viáveis para a gerência, ao mesmo tempo em que ganhariam maior autonomia para implementar ajustes locais em suas rotinas diárias, valorizando assim seu know-how, sua saúde e seu bem-estar.

PALAVRAS CHAVE: Análise Ergonômica do Trabalho (AET); Fábrica de Confecção; Ergonomia Participativa; Organização do Trabalho; Saúde do Trabalhador.

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1. INTRODUCTION

The Brazilian Textile and Apparel Industry (TAI) holds a prominent position on the global stage as it maintains one of the last fully integrated production chains in the Western world, ranging from fiber production to the final manufacture of garments (Abit, 2019). According to 2019 data, Brazil ranks as the fourth-largest global producer of apparel. Currently, it is impossible to separate the textile sector from the fashion and apparel segment (Aragão; Lima; Moreira, 2014; Mendes, 2018).

The apparel industry represents one of the main economic activities generating employment and income in the country, being the second-largest employer in the manufacturing sector, with 1.5 million direct jobs and approximately 8 million indirect jobs. Of the total workforce, 75% are women, distributed across approximately 25,200 formal companies (ABIT, 2019). In the Northeast, the state of Ceará stands out, leading regional apparel production; in 2017, it was the largest exporter in the region, surpassed only by Santa Catarina, São Paulo, and Rio de Janeiro - states with a larger industrial scale (Mendes, 2018)

This sector is characterized by heterogeneity and fragmentation, encompassing a wide variety of products and production processes (Guiraldelli, 2012; Muniz, 2016). In this context, the diversity of models and the strong influence of fashion create specific niches that do not always allow large companies to operate. On the other hand, the high level of production flexibility required can sometimes make small businesses that cannot withstand market fluctuations economically unviable. This diversity is reflected in both the products and the target audience, ranging from high-value-added niches to mass-market consumption (Muniz, 2016).

In order to analyze labor relations in the apparel manufacturing sector, based on the activities described and the situations experienced in this reality, this study adopts an interdisciplinary approach guided by the theoretical lens of Ergonomics. As a scientific discipline focused on the interactions between human beings and production systems, Ergonomics considers the physical, organizational, and psychosocial aspects of work. Its scope goes beyond merely promoting well-being; it also encompasses the analysis of production losses, quality

deviations, rework, scrap, operational delays, and human errors, seeking to understand work activity in its entirety – both its successes and its failures – in order to transform working conditions and simultaneously enhance organizational reliability and performance (Falzon, 2007; Iida; Guimarães, 2016).

In this context, Ergonomic Work Analysis (EWA) seeks to understand working conditions, identify the factors that influence work activities. Rather than focusing solely on health and safety, EWA aims to propose interventions that address a broad spectrum of operational and organizational issues – including unexpected interruptions, machine adjustments, material supply failures, interpersonal conflicts, rework demands, and the disconnection between quality control criteria and real production variability. By tackling these operational difficulties, EWA simultaneously contributes to the prevention of work-related illnesses and the improvement of production quality and efficiency (Maciel, 2014). It emphasizes the analysis of actual work – that is, what workers actually do in real-world situations. Its focus is on understanding the “doing” in specific contexts, integrating material and organizational conditions with lived experience (Abrahão et al., 2009; Guérin et al., 2001).

Given the company's interest in understanding working conditions and their implications for workers' health and production performance, an Ergonomic Work Analysis was carried out in the differentiated sewing sector. This study aimed to conduct an EWA in a garment factory sector in order to identify the organizational, environmental, and operational factors affecting seamstresses' work activity and to propose recommendations for improving working conditions and promoting workers' health. The application of EWA makes it possible to consider the specificities of the analyzed context, identifying both the objective aspects related to working conditions and work organization, as well as subjective aspects, such as perceptions, meanings, and coping strategies, integrating these dimensions with the workers’ experiences, knowledge, and limitations.

2. LITERATURE REVIEW

The production process in the apparel industry is structured as a series of stages that include design, preparation, cutting, patternmaking, sewing, and finishing. From the perspective of work organization, a clear division of roles can be identified: the initial stages of the process, ranging from design to pattern development, typically involve professionals considered more skilled and who receive higher wages, with these positions traditionally held by men. In contrast, the final phases of the production chain, such as sewing and finishing, are predominantly performed by women. These roles correspond to the most vulnerable segment of production, marked by low wages, precarious labor rights, and long working hours, which expose female workers to serious health risks (Gonçalves; Aquino, 2017).

Historically, the transition of female labor from repetitive activities in the countryside to textile factories was facilitated by the domestication of skills, such as sewing. However, within the industrial structure, this skill is often taken for granted as an attribute intrinsic to the female

gender, rather than as a technical qualification deserving of recognition. This perception sustains labor relations marked by a rigid division of tasks, high repetitiveness, and professional undervaluation. Such a scenario of precariousness is widely discussed in the literature as a factor that exacerbates physical and mental strain, as emphasized by Hirata (2016), Gonçalves and Aquino (2017), and Guiraldelli (2012).

2.1 ERGONOMICS AND WORK ANALYSIS

Ergonomics focuses on the human being and work in a broad sense, taking into account the different realities, contexts, and factors that influence this relationship and the production system, while considering human characteristics as well as those of technical and industrial systems (Abrahão et al., 2009; Falzon, 2007; Iida; Guimarães, 2016; Maciel, 2014; Ollay; Kanazawa, 2016). The Brazilian Ergonomics Association (Abergo) adopts the definition of Ergonomics from the International Ergonomics Association (IEA), presented in 2000. It is a scientific discipline “that aims to study the interactions between humans and the other components of a system, and the profession that applies theoretical principles, data, and methods with the goal of optimizing people’s well-being and overall performance” (Falzon, 2007, p. 6).

From this ergonomic perspective, task and activity are distinct elements. The task is what is prescribed by the organization – that is, a set of duties to be performed by the operator through various dimensions and procedures – but it does not take into account the particularities of the person performing them (Falzon, 2007; Guérin et al., 2001; Maciel, 2014). Thus, the task considers the characteristics of the methods, materials, and machines available, the physical environment, and communication, as well as the social characteristics of the work, without considering the individual characteristics of the operators. Thus, “the prescribed task is what is explicitly expected of the operator” (Falzon, 2007, p. 9).

Work activity, on the other hand, is the central element that organizes and structures the components of the work situation, in addition to unifying the technical, economic, and social dimensions of labor. It is defined as what the worker does, in the way it is performed – that is, what the worker mobilizes to carry out the task in real time, the so-called strategy of adaptation to the prescribed work situation. It is considered “the gap between the prescribed and the real, the concrete manifestation of the contradiction ever-present in the act of working, between ‘what is asked for’ and ‘what the task demands’” (Guérin et al., 2001, p. 15). The authors emphasize that the outcome of the activity is unique and, to carry it out, workers draw on their own characteristics, causing personal traits to emerge in response to work situations and their components.

Work activity integrates, on the one hand, the worker with their specific characteristics, acquired experiences, and pace. On the other hand, it involves the company and its operating rules, based on the context in which the work is performed, its objectives, tools, organization, distribution of tasks, and environment. Between the worker and the company lie contracts, negotiations, regulations, and the work activity itself. In the outcome of the activity, both production and the consequences – whether negative or positive – for the workers must be taken

into account (Guérin et al., 2001). The EWA aims to understand the conditions and organization of work and, “where possible, to propose suggestions for modifications to the work environment, machinery, equipment, and other aspects of the work context, such as the organization of tasks, in order to promote well-being and prevent accidents and illnesses” (Maciel, 2014, p. 163).

From an epistemological perspective, EWA seeks to understand the interaction between the individual and their work context. Its primary focus is on the work actually performed by the worker, aiming to understand their actions within a particular context, based on specific situations. EWA invites us to observe and examine what links the material and organizational conditions of work, in order to conduct a comprehensive analysis (Abrahão et al., 2009; Guérin et al., 2001; Falzon, 2007; Iida; Guimarães, 2016; Ollay; Kanazawa, 2016).

With regard to work itself, we consider the polysemic and complex nature that constitutes the socio-technical system. According to Leplat (2020), in this relationship, the worker interacts with their work tools, technical environment, and certain rules. Therefore, in the analysis of work, it is essential to consider working conditions and their effects on the activity. Working conditions are understood to include all conditions external to workers: instructions, work rules, technological conditions, objects, technical terminology, and behaviors that encompass multiple determinants (Leplat, 2020).

According to Guérin et al. (2001) and Abrahão et al. (2009), the primary purpose of ergonomics is to adapt the work environment to the individual in order to minimize negative impacts on workers and ensure adequate productivity. However, it should not be understood merely as a theoretical-methodological tool aimed at increasing productivity; it is necessary to consider that the organization of work must allow for a space with conditions conducive to worker autonomy (Gonçalves; Aquino, 2017). In this sense, it is important to bring to light the elements involved in the work context based on a more concrete understanding of the situations, in accordance with the general framework for constructing an EWA process (Guérin et al., 2001).

The starting point is an analysis of the demand, identifying the general factors involved in its formulation. Another essential step is identifying the context, through an exploratory assessment of the company’s operations and aspects such as: characteristics of the workforce, the production process, and key performance indicators. Next, an analysis of the technical process and tasks is conducted, based on broad and open observations, to formulate a diagnosis of the situations to be analyzed through a systematic observation plan. Guérin et al. (2001) emphasize that, at this stage, interaction with the workers is necessary, taking into account their verbalizations regarding their work and the activities performed. In short, EWA takes into account the specificities of the work context of this research, including the activity, the workers’ subjectivity, their experiences, knowledge, and limitations. It is therefore considered that there is always a “distance between the prescribed (task) and the activity (day-to-day work); this distance is the concrete manifestation of the contradiction present in the act of working” (Maciel, 2014, p. 164).

3. METHODOLOGY

The study is predominantly qualitative in nature, consisting of exploratory and descriptive research. EWA is an interactive method suitable for understanding the complexity of work in contexts involving prescriptions, norms, and regulatory instruments of the activity. To conduct the EWA at the factory, the guidelines of Guérin et al. (2001) were followed regarding the general framework of the approach for ergonomic action. Therefore, the methodology was structured into interconnected stages, aiming to understand the significant elements of everyday work situations and build knowledge for improvement proposals (Abrahão et al., 2009; Guérin et al., 2001).

The demand for the EWA emerged from the company's interest in understanding the working conditions in the differentiated sewing sector and identifying factors that could affect workers' health and production performance. The analysis was also intended to support the identification of critical issues in work organization and provide evidence-based recommendations for improving working conditions.

The EWA was conducted through the following stages: 1) Analysis of the demand and context, gathering information from key individuals and management; 2) Data collection on the functioning, dynamics, and population of the company; 3) Definition of the locus (analyzed sector); 4) Analysis of the technical process and tasks through simple and systematic observations; 5) Interaction with seamstresses, supervisor, and production leader; 6) Definition of observation protocols and interviews; 7) Diagnosis of work situations; and 8) Feedback session for validation and improvement proposals. Prior to the analysis, a technical visit was conducted to familiarize with the facilities. A workstation is the production unit that involves the worker, equipment, environment, and tasks performed; therefore, it can be considered a cell where the human being is the core (Iida; Guimarães, 2016).

Grounded in Regulatory Standard 17 (NR-17), this analysis sought to identify inadequate environmental and organizational conditions. The work situation was considered by describing the physical environment (lighting, noise, temperature), furniture, and organizational aspects (division of tasks, pace, control, and technical standards) (Abrahão et al., 2009; Guérin et al., 2001; Maciel, 2014).

3.1 LOCATION AND INITIAL PROCEDURES

The study was conducted at a medium-sized clothing factory in Fortaleza, Ceará. The selection was made by convenience, and access was authorized by the industrial management. The analyzed sector is subdivided into four subgroups: 1) Basic; 2) Differentiated; 3) Beachwear; and 4) Sweatshirt/Polo Collar. The EWA focused on Subgroup 2 (Differentiated).

3.2 PARTICIPANTS

Fourteen women (seamstresses, assistants, and a supervisor) with formal employment contracts participated. The inclusion criteria were: age over 18 years, minimum of one year of experience in the role, and signing of the Free and Informed Consent Form. In addition to the operators, informal conversations were held with the timekeeper and the person in charge of the Human Resources sector to understand the prescriptions and control of operations.

3.3 INSTRUMENTS

Data were obtained through semi-structured interviews, a sociodemographic questionnaire, direct observations, document analysis, and photographs. The observations followed the work analysis protocol adapted from Chicoine, Tellier, and St-Vincent (2006). The interviews were conducted in the cafeteria after lunch, when the space was already empty, providing acoustic comfort for the participants. These interviews were useful for capturing the workers' global perceptions of working conditions, career trajectories, and reported difficulties. However, according to Wisner (2025) and the ergonomic literature on activity analysis, accessing the 'how' of work – the gestures, temporal adjustments, and regulatory strategies that constitute the real activity – requires observational records followed by self-confrontation techniques, conducted during or immediately after the action (Guérin et al., 2001; Faria; Camargo, 2024). Interviews conducted outside the workstation, although valuable for understanding the prescribed task and general working conditions, do not fully capture the variability and the often-automatized regulations that workers themselves may no longer perceive as problematic (Andrade; Tonin, 2024; Castro; Oliveira, 2022; Lousada, 2023). Thus, while the interviews provided important contextual information, the analysis of the real activity – understood as what workers actually do to cope with unforeseen events, interruptions, and operational variability – was primarily based on systematic observations at the workstations, complemented by informal verbalizations during the action.

The photographs were used to document the physical configuration of the workstations and the material conditions of the activity, while preserving the identity of the participants and the company through the use of masking. However, it is important to note that photographs alone do not capture the dynamic dimension of real work – that is, the gestures, temporal adjustments, and regulatory strategies that constitute the activity itself (Partido; Henderson, 2021). Access to these dimensions requires observational records complemented by verbalization techniques, such as self-confrontation interviews conducted during or immediately after the action (Faria; Camargo, 2024; Lousada, 2023).

3.4 DATA ANALYSIS

The collected material was classified and grouped according to Content Analysis (Bardin, 1977; Mendes; Miskulin, 2017). The thematic categories were constructed based on the research objective, integrating the empirical data from interviews and observations with the work analysis protocol (Chicoine; Tellier; St-Vincent, 2006) and the theoretical framework of EWA.

4. RESULTS AND DISCUSSION

The EWA was conducted at a clothing factory founded in 1986, consolidated as a market reference and responsible for approximately 335 direct jobs. The analyzed group is located in the center of the knitting sector's warehouse, comprising about 60 seamstresses under the supervision of a direct manager and the support of the production leader (assistant). In addition to these roles, the sector has technical support provided by a timekeeper and a machine mechanic. It is worth noting that the factory does not have a formal training program; after hiring, the learning process occurs mostly through hands-on experience, through direct experience at the workstation and the transmission of know-how among the operators. The production space is organized into islands composed of four grouped machines. In front of these islands is the production assistant's table – a professional who coordinates the group, responsible for supplying workstations, monitoring goals, and controlling the production pace.

Each operator receives batches of pieces, the quantity and composition of which vary according to the operation to be performed. These batches are sent to workstations equipped with specific machines for each type of activity. Thus, the sewing cycle of a piece is not completed at a single station but fragmented among different operators. In the subgroup called Differentiated, the organization into islands follows the sequential logic of the production process.

The dynamics of production and the definition of goals are directly linked to the type of piece and the knitted fabric model used. This factor introduces variability into the process, since certain fabrics, such as Dry, used in sportswear, are more prone to technical failures, such as irregular stitches, needle breakage, and thread breakage. In these situations, the operator must intervene promptly, adjusting the machine, replacing the needle, or reconfiguring the thread. These adjustments, frequent in more complex models, slow down the process and require greater attention and effort from the workers (Figure 1).

Figure 1 - Images of the Knitting Sector – Differentiated Group.

Source: Araújo (2020).

The majority of seamstresses are multi-skilled and use Personal Protective Equipment (PPE), such as masks and ear protectors. On the production line, each operator is responsible for a specific stage of making the final garment, such as joining shoulders, attaching the collar,

setting sleeves, or closing side seams. No worker in the differentiated group completes the entire piece; their role is restricted to the operations corresponding to the production line supply. Table 1 presents the basic operations and the daily production of each operator, as defined in the technical sheet of the production reference.

Table 1- Basic operations of the Differentiated group

Operation	Production/day
Join shoulder and prepare collar	802 pieces
Attach collar	932 pieces
Sweater	1,111 pieces
Drawstring	375 pieces
Set sleeves	802 pieces
Close side seam	713 pieces
Hem	680 pieces

Fonte: Araújo (2020)

It is possible to observe that, in some operations, the volume produced is lower due to the complexity of the process. This form of work organization reveals characteristics of high repetitiveness and low variability, factors that can imply biomechanical and cognitive overload. Furthermore, polyvalence (multi-skilling), although constituting an organizational flexibility strategy, may result in work intensification, as it requires seamstresses to quickly adapt to different operations. There is a process prescription: each new model entering production comes with a pilot piece and a reference sheet; from then on, the production process time is controlled to enter the supply chain.

The workstations present themselves as dynamic units, constantly adapting to the demands of the production process. Each station has an adjustable swivel chair with padded seat and backrest, promoting posture and operator comfort. On the table, there is a small box for personal use and auxiliary tools such as tweezers, pliers, scissors, and a key for machine adjustment, ensuring quick access to necessary tools. The use of improvised adaptive solutions was also observed, such as paper cones to cover the thread tubes, whose function is to reduce thread breakage caused by fan wind and minimize production interruptions. Despite these adaptations, such solutions indicate risks such as awkward postures, repetitive movements, and the need for constant attention.

A table with information about the operation, product type, machine, and production control of the piece with production quantities is fixed on the operators' tables. If the production assistant notices that production is slow and far from the established time, she calls attention and "runs the flip-flop so as not to delay the group's production" (statement from the production assistant).

The standard time varies according to the type of piece: for the basic model, it is 0.46 minutes per piece (approximately 28 seconds); for the model with seams, 0.52 minutes per piece (about 31 seconds); and for the XL model, approximately 0.56 minutes per piece. The table fixed on the machine specifies the production targets associated with different performance levels. In

a 60-minute period, the estimated production at 100% efficiency is 130 pieces (basic model), 115 pieces (with seams), and 107 pieces (XL). These values decrease to 117, 104, and 96 pieces when considering 90% performance, and to 104, 92, and 86 pieces at 80%. Thus, the data show that productivity is directly related to the standard time of each operation and the level of operational efficiency achieved.

The timing of operations is defined by the timekeeper, and the production assistant controls this pace so that targets are met. The centrality of productivity and control, evidenced in the data, also appeared in the workers' reports. One of the interviewees, a seamstress and machine operator with 16 years of experience at the factory, highlighted:

> We have a rhythm and production control; we write down all the pieces we make during the day. (...) For each operation you are doing, you have to keep an eye on it. You finish one operation, and you already check to pass it forward so you don't have to go back. I finish making a sweatshirt, and I already look to see if it's right – I always look. It requires attention all the time (Statement from a seamstress/machine operator).

This testimony highlights the continuous attention required in the production process of the garment, as well as the constant pressure inherent to the activity. In addition to the basic operations, some specific models made by the differentiated group require longer operations that demand greater attention from the operator. It is observed that the production process follows the just-in-time model, characteristic of the Toyotist system (Araújo, 2020).

The daily target for the differentiated group is 1,180 pieces, corresponding to 100% of the production standard. Both targets and times are controlled daily and defined for each operation through timekeeping. According to the timekeeper, each seamstress has her own pace and skill, with a minimum production percentage to be achieved. In general, a production of 860 pieces per day, equivalent to 80% of the standard, is considered acceptable. From the perspective of EWA, it is observed that labor relations in this context are structured by a management model that imposes rigid targets and constant pressure mechanisms. This configuration intensifies time pressure and mental load. The overlap of production and surveillance demands tends to increase tensions and reduce autonomy, as expressed in the following testimony:

> When the target is low, she asks what happened. Even if she saw it, she wants to know from me what happened. I am held accountable. When they complain, I say: 'I am held accountable just like you are. I am responsible for your group. I am a person who is paid for this, so I need to earn my salary (Statement from the production assistant).

In addition to target control, standardized tasks are permeated by subsidiary activities, such as: interruptions to fix pieces with minor defects or production incidents, problems with machine adjustments, thread breakage, etc. – events that are apparently sporadic but are part of daily tasks and interrupt the normal production flow. Furthermore, at certain times, operators switch from one process to work on another that is more urgent.

Regarding task demands, operators excessively use their upper limbs to sew and handle pieces at the workstation. The production cycle is characterized as highly repetitive and fragmented, especially in tasks with shorter cycles, such as attaching collars and side slits.

Changing the thread according to each reference is part of the task; thus, if there is a variation of five colors, the operator changes the thread five times during the operation. For example: in a small batch of 200 pieces, the operator took 2 hours and 30 minutes to perform the operation, then changed the thread, and so on throughout the workday. If the thread breaks more than twice during the process, the mechanic is called to resolve the machine problem.

It was found that the physical space is limited, somewhat tight for circulation among the seamstresses in the islands, whether for receiving supplies, placing finished pieces, or even for performing the operation and organizing small parts or filling out the form for the references that accompany the batch to be made. Each batch is tied with a drawstring, and attached to it is a bag containing the form with the batch number, quantity, and reference to be produced by the seamstress herself, thus showing what she produced that day. At the end of the day, this record is handed to the assistant, who calculates individual and sector production.

From the EWA, based on Guérin et al. (2001) and Iida and Guimarães (2016), several critical aspects that directly impact the organization and the health of the workers were identified. Among the main points observed, the following stand out: physical environment with high temperature and noise levels; reduced spaces for circulation and supplying pieces at workstations; limited area for allocating batches and pieces in production; recurrent difficulties in station supply; inadequate positioning of machines, disconnected from the logical sequence of the production process; performance of repetitive work in a seated position, favoring the development of work-related musculoskeletal disorders (WMSDs); unpredictability in rework, caused by the return of pieces rejected by the quality sector; interpersonal conflicts between operators and supervisors, especially when production failures are identified; overload of responsibilities assigned to the production assistant; seamstresses' reports regarding lack of support from the supervisor, which, according to their accounts, manifests mainly in three situations: (a) when they request help to resolve machine problems or thread breakages and receive no timely assistance; (b) when they are held accountable for production delays caused by factors beyond their control, such as quality-related rework or material supply failures, without the supervisor interceding or renegotiating targets with management; and (c) when they propose adjustments to improve the workflow – for example, regarding the organization of batch supply or the layout of machines – and their suggestions are neither heard nor considered (statement from seamstress, personal communication, 2020). This perception of lack of support contributes to the intensification of psychological distress and reinforces the rigid hierarchical structure described below, as it removes from the operators any possibility of influencing decisions that directly affect their daily work.

The issue of rework deserves particular attention, as it was identified by the workers as one of the main sources of stress and overload. According to the seamstresses' reports and the observations made, the causes of sewing defects that lead to quality-related returns are multiple and interrelated. First, the variability of the fabrics – especially technical fabrics such as Dry, used in sportswear – directly affects the sewing process, as these materials are more prone to irregular stitches, needle breakage, and thread breakage (see Figure 1). Second, the quality of the thread and the condition of the needles appear to be critical factors: workers reported that thread breakage occurs more frequently when the thread is of lower quality or when the needle has

exceeded its useful life. Third, machine maintenance is carried out reactively – that is, the mechanic is called only when the problem becomes recurrent – rather than through a preventive schedule, which contributes to the unpredictability of interruptions. Fourth, there is a disconnection between the quality control criteria and the real production variability: the quality sector operates under rigid technical standards that do not consider the inherent variability of the fabrics and the machinery, which leads to the return of pieces that, from the operators' perspective, are acceptable. Finally, the lack of formal training and the learning process based on 'hands-on experience' mean that new operators acquire knowledge through trial and error, which can increase the occurrence of defects until they develop the necessary expertise. The workers themselves suggested, during the feedback session, that the implementation of a collective space for discussing quality criteria – involving operators, the quality sector, and management – could reduce rework rates by aligning expectations and incorporating the workers' practical knowledge into the definition of quality standards.

Despite these weaknesses, the EWA also allowed highlighting some positive aspects in the organizational context. The workers demonstrated a sense of belonging and identification with the company; the number of complaints about physical pain was considered reasonable, with no high incidence; there is provision and use of PPE; the workday included releasing workers on Friday afternoons (in effect at the time of data collection); there had not been, up to that point, strict imposition of targets or production time, as production demand was low; furthermore, polyvalence (multi-skilling) was observed as a resource present in the work dynamic. As Guérin et al. (2001) recommend, all aspects identified in the EWA imply the collective involvement of the different actors in the organization. The confrontation of viewpoints, advocated by the authors as a fundamental part of the ergonomic action, was conducted with the seamstresses through feedback sessions in which the global observations recorded by the ergonomist were presented and discussed. It is important to acknowledge, however, that this procedure does not fully correspond to the self-confrontation technique as originally proposed and developed by the French ergonomics school (Medeiros-Costa et al., 2024). In classical EWA, self-confrontation involves confronting the worker with recordings (video or audio) of their own activity, during or immediately after the action, in order to access the senses of gestures, the temporal adjustments, and the regulatory strategies that are often not verbalized in retrospective interviews (Maciel, 2014). In the present study, due to operational and ethical constraints regarding video recording, the analysis of the real activity was based primarily on systematic observations and informal verbalizations during the action, followed by collective validation sessions. Although this approach allowed the identification of the main critical points and the workers' perceptions, the absence of systematic self-confrontation limits the depth of the analysis of the regulatory strategies and the 'senses of gestures' – which may have compromised the robustness of some recommendations. This limitation is recognized and should be addressed in future interventions, through the incorporation of video recording and self-confrontation techniques, as recommended by the literature (Abrahão et al., 2009).

The factors listed above – especially rework, rigid targets, interpersonal conflicts, and restricted autonomy – are well documented in the ergonomic literature as determinants of psychosocial distress in repetitive production lines (Rahman et al., 2024; Şentürk; Kuzu Durmaz, 2024). Studies on the garment industry consistently show that the combination of high

repetitiveness, intense time pressure, and low decision latitude generates a scenario of chronic stress, which manifests both in physical symptoms (musculoskeletal pain, fatigue) and in psychological suffering (anxiety, dissatisfaction, feelings of injustice) (Melo Junior, 2012). The literature also offers critical analyses of the interventions commonly proposed to address these problems, such as imposed breaks, job rotation, and workplace gymnastics. According to Guérin et al. (2001) and Falzon (2007), these measures, when implemented in a top-down manner without the participation of the workers, tend to be ineffective or even counterproductive, as they do not address the organizational determinants of the strain and may increase the perception of control and injustice. The state of the art in ergonomics suggests that effective interventions must be based on the collective analysis of the activity by the workers themselves, through devices such as the 'Work Activity Debate Space' (Rcoha et al., 2015), where operators can, in a protected environment, confront their viewpoints, identify the root causes of the difficulties, and propose concrete solutions to the management. In the case analyzed, the workers' suggestions for improving the situation included: (a) revising the production targets to take into account the variability of the fabrics and the interruptions inherent to the process; (b) creating a direct communication channel with the quality sector to negotiate the criteria for returning pieces; (c) implementing a preventive maintenance schedule for the machines, to reduce the unpredictability of breakdowns; and (d) establishing a collective forum, mediated by an external facilitator, where they could discuss work organization issues without fear of reprisals.

4.1 PHYSICAL ENVIRONMENT

The physical environment of the analyzed workstations has good conditions in terms of chairs and machinery. The lighting in the sector is not natural but is considered adequate. The workspace of the differentiated group has little natural ventilation, and fans are used to mitigate the heat. Regarding noise, the environment has high noise levels. In addition, there is an accumulation of dust left by the fabric handled by the operators. As points to be improved, it is possible to highlight the high temperature in the environment, noise, and fabric dust. Regarding thermal overload and dust concentration, it should be noted that PPE – such as masks and ear protectors – mitigates exposure to dust and noise but does not eliminate the risk of heat stress, nor does it address the root causes of the thermal discomfort reported by the workers. As a structural recommendation, the installation of natural cross-ventilation openings on both sides of the production shed is suggested, which would allow for air circulation and reduce the dependence on fans that, as observed, contribute to thread breakage (Guérin et al., 2001; Iida; Guimarães, 2016).

The production assistant is required to carry batches of pieces to supply the workstation after the sewing cycle is completed; the batches can be carried on carts. The pieces are loaded manually and can be placed on carts and sized according to the sector’s production capacity for the day. The carts can move through the spaces between workstations and in the aisle, covering the entire production process.

4.2 PSYCHOSOCIAL ENVIRONMENT

The psychosocial environment encompasses intrinsic aspects of work in garment production, such as: sense of security, career progression, perception of the company's image (positive), social relationships with colleagues, and benefits. The psychosocial environment was identified as positive, although there were some conflicting situations regarding work organization, with changes in production rhythm due to demand.

According to Guérin et al. (2001), there are time constraints that interfere with psychosocial environments. Often, production time pressure results from a combination of associated elements, whether from norms and production prescriptions, or from environmental limitations and deadlines to resolve interferences that arise and are beyond control, such as priorities that disrupt production, in addition to waiting and the availability of threads and materials for production.

4.3 WORK RHYTHM AND ORGANIZATION

The analyzed tasks have different contents with varying productivity levels and work rhythms depending on the model and reference being made. These factors must be taken into consideration, and possible improvements need to be considered based on the following measures: introduction of breaks and job rotation. Introducing breaks does not necessarily mean a decrease in production; at certain times, it helps in the recovery of the musculoskeletal system, allowing movements to resume at a different level of productivity, in addition to preventing the harmful effects of fatigue and cognitive functions. In general, short breaks with small intervals are more effective than long ones after several hours of work (Iida & Guimarães, 2016). However, the literature on repetitive work in production lines warns that imposed breaks – especially when strictly timed and not negotiated with workers – can generate a paradoxical effect: upon returning from the break, operators may feel pressured to accelerate their pace to compensate for the lost time, which can increase rather than reduce musculoskeletal and cognitive strain (Gonçalves; Aquino, 2017; Abrahão et al., 2009). Studies suggest that self-selected or collectively negotiated breaks are more effective and better accepted, as they allow workers to regulate their own pace according to the demands of the task and their own physical condition (Guérin et al., 2001; Falzon, 2007).

Regarding rotation, it is considered that rotating operators contributes to reducing monotony and combating fatigue. Rotation is suggested since the seamstresses spend a long time in a seated position performing repetitive operations. However, the data indicate that some form of rotation already occurs informally, driven by operational needs – for example, when operators are relocated to more urgent tasks or when they substitute for absent colleagues. The workers' reports, however, do not suggest that this rotation is experienced as a positive resource; on the contrary, it is perceived as another source of work intensification, as it requires rapid adaptation to different operations without corresponding recognition or remuneration. Rather than imposing a formal rotation schedule from above, the ergonomic literature recommends that rotation be collectively negotiated among the operators themselves, granting them autonomy to

define, within certain limits, the pace and distribution of tasks among the group (Guérin et al., 2001; Falzon, 2007). This approach would not only reduce the monotony and biomechanical overload inherent to repetitive work but also counteract the effects of the rigid hierarchical structure described below, by restoring to the workers a margin of decision-making over their own activity.

5. CONCLUSIONS

The analysis of working conditions required a comprehensive approach, capable of integrating the multiple elements that constitute work activity, such as the physical environment, interpersonal relationships, division of tasks, and work organization. The feedback session with the workers, conducted after the EWA was applied, enabled an in-depth understanding of the strategies used in daily production and the variations faced at the workstations. The differential of this study lies in the direct observation of real work, combined with the company's institutional openness to conducting the analysis and the feedback sessions.

During the investigative process, difficulties in work organization were reported, along with stress-inducing factors, especially rework demanded by the quality sector. The production models adopted, focused on serial production of garment parts, contribute to the simplification of tasks but intensify the repetitiveness of operational cycles. This configuration negatively impacts workers' health, as demonstrated by frequent complaints of physical discomfort, often not verbalized but evidenced by the continuous use of lumbar support belts as a strategy to maintain production rhythm. Psychological distress also manifests, exacerbated by the monotony of tasks and the low variability of work.

The rigidity of the hierarchical structure observed in the analyzed organization significantly limits the operators' autonomy. Decisions regarding work activities originate from management and go through different levels until reaching the production leader, who distributes orders to the workers. This configuration reduces the possibility of decision-making at the operational level, contributing to the de-characterization of the seamstresses' know-how.

The implementation of the EWA was made possible by the commitment of the company's management in allowing access to the factory environment and work routine. This stance demonstrated sensitivity to the identified ergonomic issues, which was essential for the complete development of the analysis. The theoretical-methodological model adopted followed the guidelines of the main authors in the field, allowing the completion of all planned stages, including feedback to the workers and management.

Among the main objectives of the EWA is the proposal of changes in processes, policies, and work organization. However, such transformations must be built gradually, respecting the specificities and limitations of the context. In the analyzed factory, the physical space restriction emerged as one of the main obstacles, exacerbated by financial limitations that make immediate changes unfeasible. Even so, raising awareness among both operators and management regarding the ergonomic approach represents a significant advancement.

Finally, it is noteworthy that delivering a final report to the company's management, with recommendations based on empirical evidence, consolidates the results of the analysis and contributes to the valorization of work and the promotion of workers' health.

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