



## STUDY OF SPECIFIC RESISTANCE OF THE BODY OF WORKERS IN THE SPINNING INDUSTRY

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### ABSTRACT

*The spinning industry is characterized by continuous physical activity, repetitive movements, exposure to dust, vibration, and noise. These occupational factors influence the specific resistance of the human body, which refers to the ability of an organism to withstand physical and environmental stressors. This study evaluates cardiovascular, respiratory, and musculoskeletal resistance among spinning industry workers. Comparative analysis with a control group reveals significant reductions in physiological resistance indicators. The findings highlight the importance of preventive occupational health strategies.*

### Introduction

A modern enterprise, where the efforts of a large number of workers are combined and where diverse production processes are employed, can operate effectively only with a rational organization of production.

Production organization should be understood as a system of scientifically based measures aimed at creating the most efficient structure for an enterprise and its divisions, as well as the appropriate combination and integration of labor and technological processes, as well as means of production, in time and space, to effectively fulfill planned targets and achieve the best end results. Thus, a unified production process is organized within the enterprise, representing a system of interconnected,

targeted technological and labor processes.

The relevance of this work lies in the fact that through rational organization of production, output can be increased without additional capital investment.

The spinning industry plays a critical role in textile manufacturing. Workers are exposed to multiple occupational stressors including mechanical vibration, high noise levels, airborne cotton dust, and prolonged standing. Specific resistance of the body represents the functional capacity of physiological systems to adapt to these stressors.

Various technological processes for producing chemical fibers are based on the synthesis of polymers from monomers or the dissolution of natural



polymers followed by the processing of high-molecular compounds. These processes can result in the release of a complex of chemicals into the environment with irritating, general toxic, sensitizing, and hematotoxic properties.

From a technological and hygienic perspective, the production of various types of fibers can be divided into three main stages: polymer synthesis or dissolution of a natural polymer and the production of a spinning solution, fiber spinning, and textile processing of the fiber.

The technological process in chemical plants is carried out continuously, in closed equipment, and, accordingly, is progressive in terms of hygiene. At the same time, some operations are accompanied by short-term (peak) but massive emissions of substances that significantly determine the level of air pollution and the degree of hazardous working conditions in these areas (monomers, solvents, reaction byproducts, etc.). Equipment heating is most often achieved using organic, high-temperature heat transfer fluids. Heat transfer fluid vapors or its degradation products may enter the air of production facilities through leaks in utility lines or through open drains from the system.

Working conditions in spinning mills depend on the fiber spinning methods used. When spinning fiber from a polymer solution, the process and equipment may release chemicals used as solvents, components of the precipitation bath, and residual monomers into the air of production facilities.

The nature of the production operations and the equipment used determine the risk of systematic contamination of workers' hands and clothing with the composition of the precipitation bath and residual monomer.

The polymer melt spinning method is characterized by the potential for the release of thermal-oxidative degradation products of the polymer, which is a multicomponent mixture whose chemical composition is determined by the polymer itself. Furthermore, when using high-temperature organic compounds as a heat transfer fluid, it is possible for heat transfer fluid vapors or thermal degradation products to be released into the air, the chemical composition of which is determined by the composition of the heat transfer fluid used and the operating temperatures.

Working conditions in textile workshops are determined by workers' exposure to noise, vibration, and the release of sizing aerosols into the air, especially in areas where fibers are heat-treated, and their contamination of workers' skin.

The work involves visual strain, requiring the ability to distinguish fine, low-contrast threads.

## **Materials and Methods**

Participants: 100 spinning industry workers and 50 control subjects.

Measured parameters included:

- Heart Rate Variability (HRV)
- Resting Heart Rate (RHR)
- Forced Expiratory Volume (FEV1)
- Grip Strength Test
- Sit-to-Stand Endurance Test

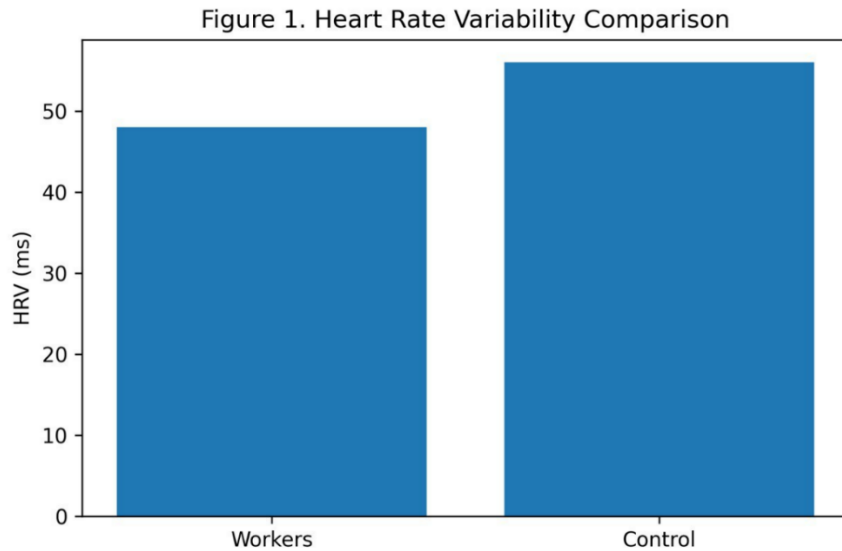
## **Results**



Analysis demonstrated reduced HRV and FEV1 values among workers with more than 5 years of service.

Musculoskeletal endurance was also significantly lower in high-exposure groups.

**Figure 1. Heart Rate Variability Comparison (Diagram)**

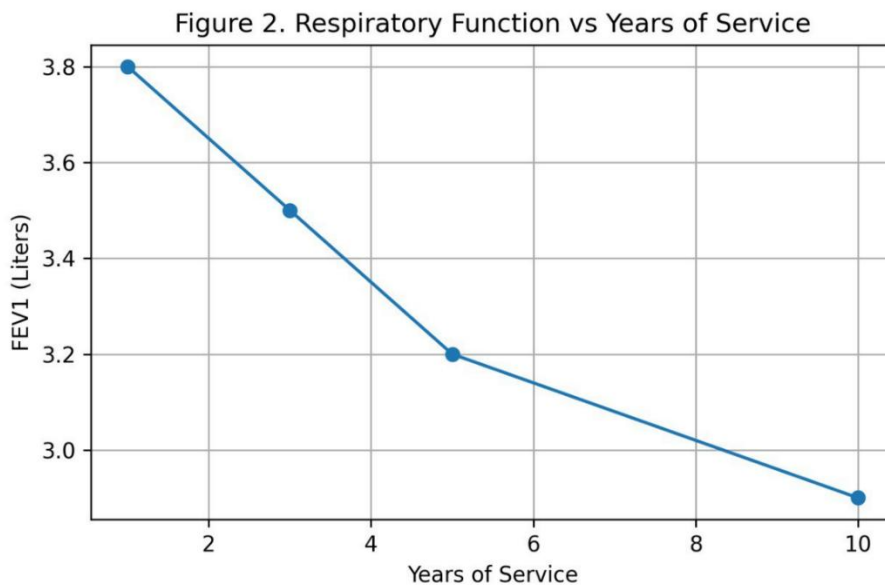


Workers: 48 ms average HRV  
Control Group: 56 ms average HRV

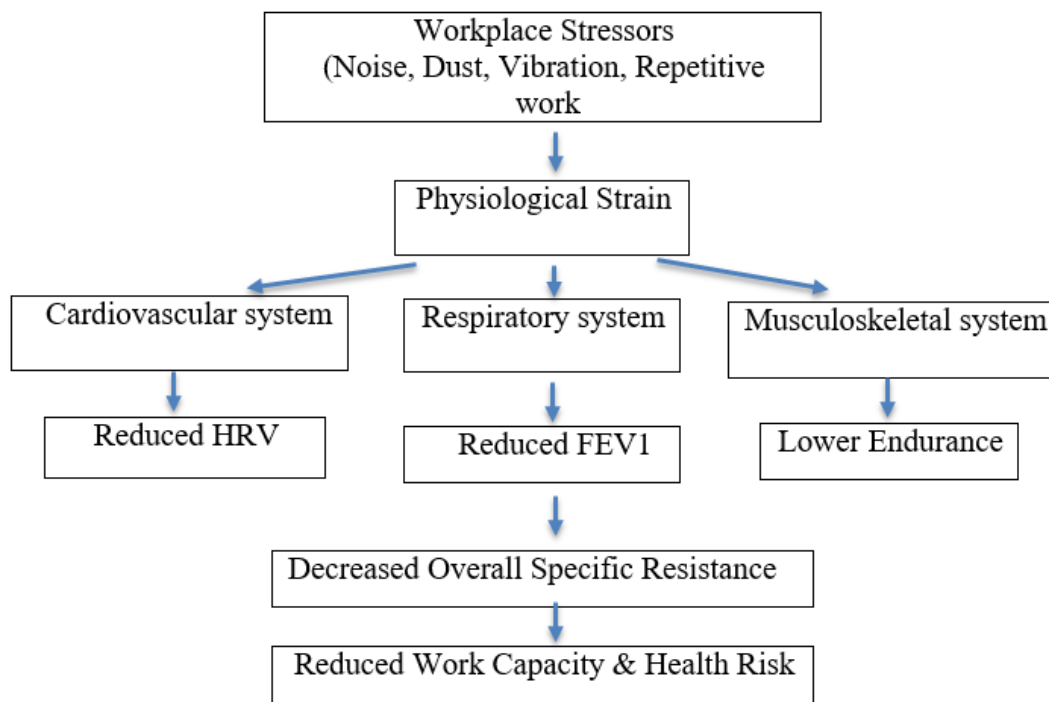
**Figure 2. Respiratory Function vs Years of Service (Diagram)**

Years of Service → FEV1 (liters)

- 1 year → 3.8 L
- 3 years → 3.5 L
- 5 years → 3.2 L
- 10 years → 2.9 L



**Flowchart 1. Model of Specific Resistance**



### Discussion

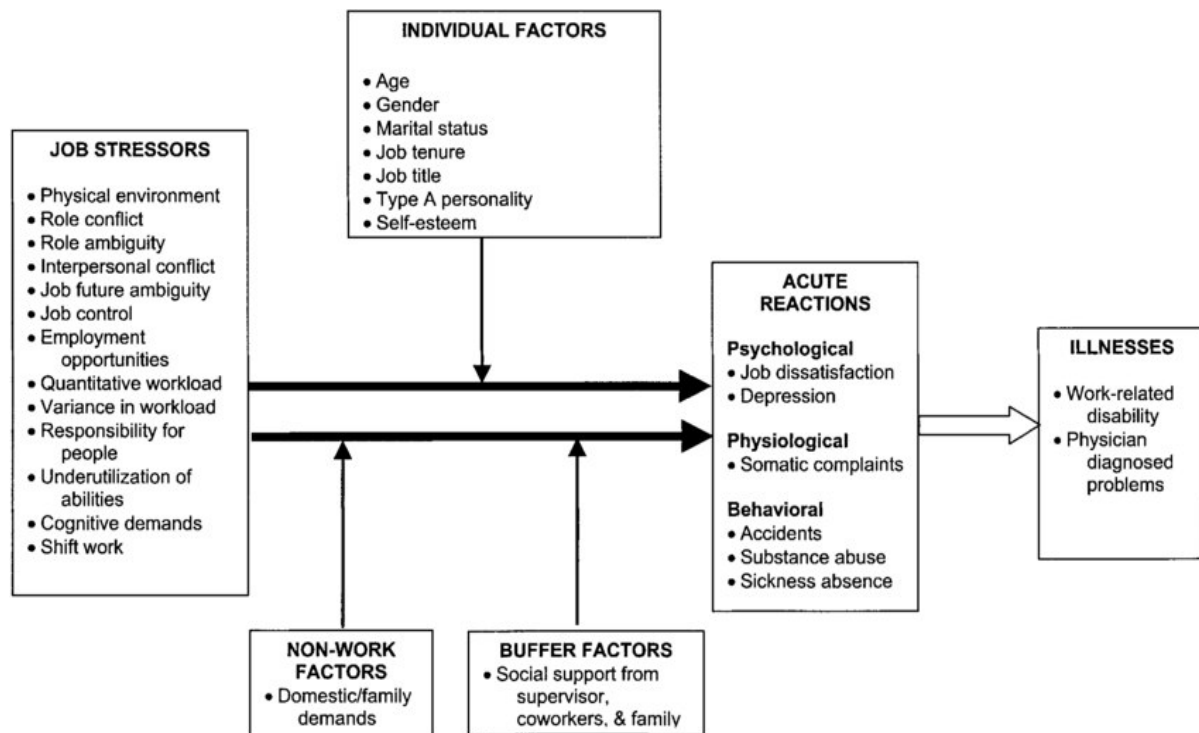
Chronic exposure to occupational stressors negatively affects workers' physiological resistance. Preventive measures such as ergonomic improvements, ventilation systems, and regular medical examinations are essential to maintain workers' health.

The NIOSH model of job stress and health (see Fig. 3), initially proposed by Hurrell and McLaney [1988], is similar to earlier formulations by Kagan and Levi [1971], Levi [1972], and Cooper and Marhsall [1976] and provides an overarching framework for understanding how adverse health outcomes may be tied to work-related factors. Based on evidence from the occupational stress literature, the model identifies multiple sources of stress in the work environment (physical environment, role conflict, role ambiguity, job control, interpersonal conflict, work load, responsibility for people, underutilization of abilities, cognitive demands, and shift work).

Accordingly, this model is distinguished from the Siegrist [1998] and Karasek [1979] models which are more restrictive in their consideration of work-related stressors. Another unique aspect of this model is the recognition that exposure to physically threatening or hazardous situations can also be a source of stress to workers. As with other occupational stress models, it is proposed that exposure to work-related stressors contributes to acute psychological, physiological, and/or behavioral reactions, referred to as "strains." These short-term reactions are believed to have the capacity to manifest themselves later as longer-term physical and/or psychological disorders or disability. Individual factors such as personality and coping, as well as non-work factors (e.g., domestic/family demands) and "buffer" factors (e.g., work and non-work-related social support), are also integrated into the model as moderators of the relationship between job stressors and acute and chronic

reactions. Therefore, like the Siegrist [1998] and other transactional models of occupational stress [e.g., French et al., 1982], the NIOSH model acknowledges the contribution of individual attributes to the stress process; however, like the Karasek [1979] model and consistent

with the public health philosophy emphasizing primary prevention by protecting individuals from exposure to hazardous environments, the model gives primacy to the role of workplace factors in the etiology of job stress.



**Figure 3. Model of job stress and health (Hurrell and McLaney, 1988)**

During the polymer melt fiber spinning process, the following should be provided:

- automated resin loading into spinning machines;
- preferential use of electric heating or a coolant with low toxicity and low volatility at operating temperatures;
- sealing of coolant lines to prevent the release of coolant vapor or its thermal degradation products into the air;
- selection of insulating gaskets resistant to the high-temperature coolant used in the process;

- adequate thermal insulation of branched coolant lines;
- equipping spinning machines for spinning synthetic cord and staple with built-in aspirated covers in the spinneret section.

Provide measures to combat noise and eye fatigue:

- replacement of metal spindles with plastic ones in the winding section of spinning machines;
- control over the precise fit of machine parts;
- contrasting coloring of the winding section of spinning machines in the thread passage area.



During process sag spinning of fiber from a polymer solution, the following should be provided:

- complete demonomerization of the spinning solution in the production of synthetic fibers using demonomerizers designed to allow for their cleaning through a closed communication system;
- preferential use of filters whose operation does not emit harmful substances into the air (e.g., with a precoat layer, reverse cleaning, etc.);
- equipping spinning machines with aspirated covers with a uniform distribution of suction speeds along the length of the machines.

When improving the technological process and equipment design of spinning mills in viscose fiber production, it is necessary to provide for:

- equipping the fiber spinning and finishing areas with covers, effective dual-mode ventilation, and an exhaust gas regeneration system with carbon disulfide recovery;
- equipping machines and units with dual-mode ventilation with an interlock system that prevents the encapsulation shields from opening

when the subcapsule space is incompletely ventilated;

- on machines producing textile yarn using the centrifugal method, ensuring the localization of gas emissions from the sand piles with carbon disulfide recovery;
- providing closed containers with mechanical transportation throughout the mill for the collection of defective fibers and tatters, which are additional sources of gas emissions into the environment;
- the fiber spinning and finishing system should include equipment for the comprehensive cleaning and degassing of process solutions (precipitation and plasticization baths, rinse water);
- development of special designs to ensure safe operation of tow cutting and ensure a stable worker's body position during this operation.

## Conclusion

The study confirms that spinning industry workers experience measurable reductions in specific resistance of the body. Implementation of occupational health interventions is strongly recommended.

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