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BIOMEDICINE AS AN ESSENTIAL TOOL IN WORKERS' HEALTH AND IN THE PREVENTION OF OCCUPATIONAL RISKS: AN EPIDEMIOLOGICAL STUDY

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ABSTRACT

Biomedicine is essential and a partner in the preventive health of workers, helping in the early identification of health changes arising from the work environment. Periodic laboratory tests tend to highlight the risk factors associated with working conditions. The aim of this study was to identify biochemical and hematological patterns in workers exposed to occupational risks. The study methodology was descriptive, quantitative, and epidemiological, with analysis of 3,428 laboratory tests from 1,145 workers, covering biochemistry, hematology, immunology, and toxicology. The results revealed alterations in 5% of the exams, with emphasis on liver enzymes and blood glucose in the biochemistry, in addition to complete blood counts in hematology, suggesting lifestyle habits and/or metabolic stress and inflammation associated with the work environment. It is concluded that regular laboratory monitoring is crucial for early diagnosis, reduction of occupational risks and development of preventive strategies, promoting the health and quality of life of workers.

Keywords: Biomedicine. Occupational Health. Prevention. Laboratory Tests. Quality of Life.

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INTRODUCTION

Occupational health has been increasingly highlighted, due to greater attention to the creation of safe and healthy work environments, especially in sectors where employees are subjected to potential risks – physical, chemical, biological, mechanical, and psychological those resulting from work organization (Rao, 2022) – present in work processes that induce stress or even chronic non-communicable diseases (NCDs) (Brazil, 2002).

In an attempt to protect the employee, the analysis of laboratory tests such as biochemical and hematological tests play a vital role in the early detection of health changes; with this, preventive and therapeutic interventions can be made, consequently improving the employee's quality of life (Zanetti; Wolf; Grando, 2022).

The aforementioned tests present a detailed picture of the employee's health status, allowing biological abnormalities to be identified before they evolve into serious occupational diseases. In recent years, studies have proven the effectiveness of regular laboratory monitoring as a diagnostic tool, capable of reducing the occupational impacts on the health of employees. The periodicity is linked to the activity developed and the occupational risk to which the workers are exposed, in addition to age (Brasil, 1978).

Authors mention that biomarkers such as cortisol, serotonin, epinephrine, and dopamine are released by the body in response to stress and can be monitored using point-of-use sensors in blood, urine, saliva, and sweat (Steckl, & Ray, 2019). Hematological tests are also used to screen for inflammation and immune response, being able to reveal changes associated with the work environment (Germolec, et al., 2018). These frequent screenings of laboratory test analyses provide greater maintenance and evaluation of occupational health. This research aimed to identify biochemical patterns of 1,145 workers in a universe of 3,428 laboratory tests collected involving a biochemical, hematological, microbiological, immunological and toxicological laboratory analysis.

From this perspective, the following problem question was elaborated: How can regular monitoring through biochemical and hematological laboratory tests contribute to the early identification of occupational risks and the formulation of preventive strategies that promote the health and quality of life of employees in environments subject to potential physical, chemical and biological exposures?

Despite the information collected, it was possible to quantify the number of non-standard tests and the nature of these changes, in order to identify potential occupational risk factors and take specific preventive measures. The results of this research will allow the

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formulation of occupational health promotion strategies focused on early diagnosis and the reduction of the negative impacts of occupational conditions.

LITERATURE REVIEW

Regulatory Standard No. 07 (NR-07) (Brazil, 1978), came into force in March 2020, updating the occupational exposure limits, benefiting from the evolution of laboratory analyses in biochemical and hematological tests capable of detecting changes linked to the work environment in the modern era. Studies have been deepened, highlighting how such tests contribute to identifying conditions that have origins in occupational risk factors (Pavlovskaya, 2019).

From this perspective, hematological tests have been shown to be useful in discovering not only inflammation, but also how changes in red and white blood cell indices can negatively reflect on the health of employees exposed to a different occupational environment (Samadi, 2019).

Authors such as Junaid; Hashmi; Malik (2016) point out that alterations in complete blood counts of employees exposed to toxic substances such as solvents and heavy metals frequently relate to hematological disorders, highlighting the urgency of continuous control for the prevention of occupational diseases. Thus, it is urgent that this class of employees carry out regular examinations, in order to prevent any type of occupational disease.

Similarly, the enzyme gamma-glutamyl transferase (GGT), widely used in biochemical examinations, has stood out as a sensitive marker for chronic exposure to toxic substances in occupational environments. According to Whitfield (2001), GGT is an enzyme involved in the metabolism of glutation, being an early indicator of liver damage caused by environmental and chemical toxins. This marker is also valued in studies such as Lee's; Blomhoff; Jacobs (2007), who associate high levels of GGT with prolonged exposure to solvents and other chemicals. The inclusion of GGT in occupational health monitoring programs, as recommended by NR-7 of the Ministry of Labor and Employment, contributes significantly to the planning of preventive and corrective strategies in workers' health.

In addition, hematological tests, such as complete blood counts, are essential in identifying infections, inflammation, and anemias, especially in high-risk occupational settings, such as the food industry and emergency medical services. The blood count evaluates essential blood components, provides crucial information for the diagnosis and monitoring of health conditions. In workers exposed to hepatotoxic substances, the

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presence of leukopenia was recorded as a sign of intoxication, especially in the case of exposure to benzene (Cazarin; August; Melo, 2007). In addition, changes in the blood count, such as leukocytosis and neutrophilia, may indicate infectious processes, being valuable tools in clinical practice. Therefore, the implementation of occupational health programs that include regular hematological examinations is a recommended practice for the maintenance of workers' health.

The integration of laboratory tests in occupational health is a consolidated practice that contributes significantly to the promotion of workers' health and to the prevention of work-related accidents. According to Santos and Silva (2021), periodic exams, such as blood count and biochemical analysis, are indispensable tools for screening chronic non-communicable diseases, in addition to enabling personalized interventions. These tests not only identified early changes in the health of workers, but also favored the adoption of preventive strategies that promote a higher quality of life.

Complementing this perspective, Mendes and Dias (1991) point out that the transition from occupational medicine to occupational health broadened the focus of occupational practices, including the constant monitoring of exposure to hired agents through toxicological profiles and regular laboratory studies. These practices make it possible to identify potential risks and adopt preventive measures that protect the health of workers, reinforcing the commitment to safer work environments. The integration of these approaches highlights the importance of occupational health programs that address both the improvement of the work environment and the well-being of employees.

METHODS

This is a descriptive, quantitative, observational and epidemiological research conducted with the objective of identifying biochemical and hematological patterns that could reflect the occupational health status of workers. The epidemiological survey was carried out at an Occupational Medicine Clinic in Curitiba, Paraná, where the internship provider company was conducted, where laboratory data from various sectors were collected, analyzed, and organized according to the established occupational health protocols.

The methodology used allowed a comprehensive perception of health standards and risk factors present in the work environment, providing valuable data for the design of health programs focused on specific evidence issues.

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SAMPLE DESCRIPTION

The sample included 1,145 workers, totaling 3,428 laboratory tests performed in different sectors of the company, with the following distribution:

- Biochemistry I: 591 tests in 426 patients, with 24 tests outside normal parameters. The main alterations involved GGT (12 cases), glucose (GLI, 9 cases) and TGP (3 cases).
- Microbiology I: 924 tests in 501 patients, all within normal parameters.
- Urinalysis: 21 tests in 21 patients, all within normal parameters.
- Parasitology: 500 tests in 497 patients, all within normal parameters.
- Immunology: 193 tests in 113 patients, all within normal parameters.
- Hematology I: 875 tests in 863 patients, with 148 tests outside the normal parameters. The main alterations were in the Complete Blood Count (144 cases), RET (1 case), COVAG (2 cases) and Lipidogram (1 case).
- Hematology II: 16 tests in 16 patients, all within normal parameters.
- Toxicology Support: 89 tests in 76 patients, all within normal parameters.
- Occupational Toxicology: 182 tests in 71 patients, all within normal parameters.
- Outsourced - DB: 37 examinations in 35 patients, all within normal parameters.

The consolidated total indicated 3,428 tests, of which 172 presented results outside the normal range and 3,256 were within the parameters.

DATA COLLECTION

Laboratory data collection was carried out through analysis of blood, urine and other body fluids, using the services of partner laboratories that processed the samples according to strict quality control protocols. The examinations included:

- Biochemical Tests: Glycemic and lipid profiles, liver enzymes such as GGT, and other biochemical markers of health.
- Hematological Tests: Complete blood count, lipidogram and other indices related to the blood system.
- Other tests: Including urinalysis, parasitology, microbiology, immunology, and toxicology, to identify additional risk factors.

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ANALYSIS OF THE RESULTS

The results were organized into two categories: "within parameters" and "outside the normality". For tests that showed significant alterations, such as GGT, blood glucose and TGP in biochemistry, and complete blood count in hematology, a referral was made for retesting. This procedure aimed to confirm the accuracy of the findings and reduce the possibility of laboratory errors.

FORWARDING AND RETESTING

In cases in which the laboratory results diverged from the clinical parameters, the tests were sent for retesting, in order to ensure diagnostic accuracy:

- Identification and Selection of Exams for Retest: Exams with altered results or discrepant values were identified and selected for replay.
- Execution of Retests: The samples were reanalyzed in the partner laboratories, ensuring the consistency of the results and diagnostic validity.
- Validation of Results: The results of the retests were evaluated and compared with the established clinical parameters to ensure the accuracy and reliability of the data.

ETHICAL ASPECTS

The research was approved by the Research Ethics Committee (CEP) of the State University of Ponta Grossa, under protocol No. 5,475,110, ensuring compliance with all ethical aspects and the preservation of the confidentiality of the workers' data, which were used exclusively for the purpose of promoting occupational health.

STATISTICAL ANALYSIS AND DATA INTERPRETATION

The data were subjected to statistical analysis to identify patterns of health change. Key steps included:

- Frequency Distribution: Used to identify the prevalence of tests outside the normal parameters in each sector.
- Variable Correlation: Applied to evaluate associations between laboratory data and potential occupational risk factors.
- Comparison with Clinical Parameters: Results compared with normal values for interpretation within the context of occupational health.

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The methodology applied allowed a broad view of health patterns and risk factors present in work environments, providing valuable data for the development of targeted and evidence-based health programs.

RESULTS

In this study, 3,428 laboratory tests performed on 1,145 workers from various sectors were analyzed, covering areas such as Biochemistry, Hematology, Microbiology, Urinalysis, Parasitology, Immunology and Toxicology. The objective was to evaluate the prevalence of tests within and outside normal parameters and to identify patterns of alterations that could indicate occupational risk factors.

DISTRIBUTION OF TESTS AND ANOMALIES DETECTED

- Biochemistry I: Of the 591 tests performed, 24 alterations were performed, the main ones being the levels of gamma-glutamyl transferase (GGT) (12 cases), glucose (GLI) (9 cases) and alanine aminotransferase (TGP) (3 cases). The altered rate of examinations was approximately 4%, which suggests biochemical alterations potentially associated with occupational exposure to chemical agents. A study conducted by Whitfield (2001) highlights that GGT is often used as a sensitive marker of exposure to toxins and oxidative stress, especially in occupational contexts where there is chemical handling.
- Microbiology I: A total of 924 tests were performed in 501 patients, all within normal parameters, reducing the absence of infections or contamination of microbiological origin. This result is consistent with studies that demonstrate that rigorous practices for the protection of surfaces and equipment are essential to reduce environmental pollution and prevent the transmission of pathogens during consultations, contributing to the maintenance of occupational health (Silva et al., 2022).
- Urinalysis: All 21 tests performed were within normal parameters, signaling good urinary health among employees and absence of changes that could indicate dehydration or urinary infection.
- Parasitology: Of the 500 tests, none showed anomalies, which is consistent with good hygiene and sanitation practices in the occupational environment.
- Immunology: The 193 tests performed on 113 patients were within normal parameters, suggesting a low rate of exacerbated immune response.

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- Hematology I: 875 tests were performed on 863 workers, with 148 results outside normal parameters. The main alterations were observed in the complete blood count (144 cases), in addition to punctual alterations in reticulocytes (1 case), coagulogram (2 cases) and lipidogram (1 case). The rate of hematological abnormalities was about 17%, reducing a possible prevalence of inflammation or anemia. Studies have shown that adverse working conditions can contribute to the development of hematological disorders, reinforcing the importance of regular monitoring and adequate instructions in the workplace (Ferreira et al., 2018).
- Hematology II: All 16 tests performed were within normal parameters.
- Support and Occupational Toxicology: In the toxicology sectors, of the 271 tests (89 of which were Detran support, Pr. - Paraná Traffic Department and 182 occupational), all were within normal parameters, suggesting that exposure to toxic substances was under adequate control.
- Outsourced - DB: Of the 37 tests performed, all presented normal results.

DATA SUMMARY

The total number of tests with abnormal results was 172, representing approximately 5% of the total. The areas with the highest prevalence of abnormalities were Biochemistry, mainly due to liver enzymes and glucose, and Hematology I, especially in complete blood count. These results are indicative of working conditions that may be contributing to the emergence of occupational diseases, reinforcing the need for continuous monitoring.

DISCUSSION

The results of this study indicate that, although most laboratory tests are performed within normal parameters, there is a significant amount of altered tests in specific sectors, particularly in Biochemistry and Hematology. The elevation of liver enzymes, such as gamma-glutamyltransferase (GGT), may be associated with exposure to chemical substances, especially pesticides, as presented by Fróes-Asmus (2021). This marker has been used as an indicator of liver stress, indicating that workers may be exposed to hepatotoxic agents or dealing with occupational stressors.

The high rate of alterations in the complete blood count, observed in 144 of the 863 Hematology I exams, suggests an incidence of inflammation or anemia possibly linked to the work environment. Studies indicate that workers exposed to pesticides have

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hematological, respiratory and genetic damage, evidencing the influence of occupational factors on workers' health (Peres et al., 2005). In addition, changes in glucose levels observed in Biochemistry exams may be associated with occupational stress, which affects metabolism and increases the risk of metabolic diseases, as planned by Sooriyaarachchi et al. (2022). Studies have shown that adverse working conditions can contribute to the development of hematological disorders, reinforcing the importance of regular monitoring and adequate instructions in the workplace (Ferreira et al., 2018).

CONCLUSION

This study analyzed a total of 3,428 tests performed on 1,145 workers, revealing that 172 had results outside normal limits. The areas with the highest incidence of anomalies were Biochemistry and Hematology, with emphasis on deviations in liver enzyme (GGT) levels, glucose, and complete blood count interruptions. These results suggest the presence of metabolic stress or systemic inflammation with no defined cause, possibly related to working conditions. The findings reinforce the need for regular and detailed monitoring of the health of these workers, using laboratory tests as an essential preventive strategy to identify early changes that may compromise their well-being and performance.

This topic is of great relevance to the field of occupational health and biomedicine, as it allows the development of integrated programs aimed at reducing occupational risk factors and improving working conditions. Biomedicine plays a crucial role in providing diagnostic support through accurate laboratory tests, allowing for the early detection of changes related to exposure to contracted agents. Companies use this data to implement comprehensive preventive strategies, such as restructuring work environments and conducting periodic biomedical assessments.

These actions not only preserve the health and well-being of workers, but also promote a safer and more productive work environment, highlighting the relevance of biomedicine as an ally in the promotion of occupational health and safety. Through the analysis of biological marker criteria and the identification of specific risks, biomedicine contributes to the creation of effective preventive policies and interventions. In this way, it strengthens the relationship between health and productivity, promoting the well-being of employees and the sustainable development of companies.

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