ENVIRONMENTAL RISK ANALYSIS: A CASE STUDY OF THE MICROBIOLOGY LABORATORY OF A HIGHER EDUCATION INSTITUTION, MARABÁ, PARÁ, BRAZIL

ANÁLISE DE RISCOS AMBIENTAIS: UM ESTUDO DE CASO DO LABORATÓRIO DE MICROBIOLOGIA DE UMA INSTITUIÇÃO DE ENSINO SUPERIOR, MARABÁ-PA

ANÁLISIS DE RIESGOS AMBIENTALES: UN ESTUDIO DE CASO DEL LABORATORIO DE MICROBIOLOGÍA DE UNA INSTITUCIÓN DE EDUCACIÓN SUPERIOR, MARABÁ, PARÁ, BRASIL

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ABSTRACT

In teaching and research institutions, where there is a high circulation of researchers, students, and technicians, various risks are evident due to the handling of biological materials, sharps, and/or chemical substances, as well as the use of different laboratory equipment. However, studies addressing risks in laboratories of teaching and research institutions and their associated factors are scarce in the scientific literature. In this context, this study aimed to analyze environmental risks in the Microbiology Laboratory of a Higher Education Institution in Marabá, Pará, Brazil. The research employed the deductive method, with a qualitative scope, applied nature, and exploratory procedure. The method was associated with bibliographic and documentary data collection, in which secondary data were obtained from specialized links and open-access databases, while primary data were obtained through visits to the laboratory, during which the activities carried out were observed over a period of three months. The data indicated the presence of the main groups of environmental risks in the laboratory, including physical, chemical, biological, ergonomic, and accident-related risks, with some presenting low risk potential. Nevertheless, ergonomic and accident-related risks were particularly significant, mainly due to chairs without backrests and exposure to UV light and autoclaves, respectively. In this regard, certain safety measures could reduce exposure to hazards, such as the acquisition of more ergonomic seating,

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enclosure of the UV light hood and autoclaves, expanded use of personal protective equipment (PPE) and safety signage, and the implementation of an Incident and Accident Log.

Keywords: Health and Safety. Safe Research. Occupational Accident. Risk Mapping.

RESUMO

Nas instituições de ensino e pesquisa, onde há grande circulação de pesquisadores, estudantes e técnicos, são perceptíveis os variados riscos, seja pela manipulação de materiais biológicos, perfurocortantes e/ou químicos, além do uso de diversos equipamentos em laboratório. Entretanto, os estudos de riscos em laboratórios de instituições de ensino e pesquisa e os respectivos fatores associados são escassos na literatura científica. Nesse sentido, este trabalho teve como objetivo analisar os riscos ambientais no Laboratório de Microbiologia de uma Instituição de Ensino Superior, em Marabá-Pa. A pesquisa empregou o método dedutivo, com abrangência qualitativa, natureza aplicada e procedimento exploratório. O método foi atrelado ao levantamento de dados bibliográficos e documentais, em que os dados secundários foram obtidos em links especializados e em banco de dados de acesso livre, e os dados primários foram obtidos pelas visitas realizadas ao Laboratório, em que foram observadas as atividades desenvolvidas por um período de três meses. Os dados obtidos indicaram a presença dos principais grupos de riscos ambientais no laboratório, incluindo riscos físicos, químicos, biológicos, ergonômicos e de acidentes, sendo que parte desses apresentou baixo potencial de risco. Todavia, apesar disso, os riscos ergonômicos e de acidentes foram bastante representativos, principalmente pelos assentos sem encosto e exposição à luz UV e autoclaves, respectivamente. Quanto a isso, algumas medidas de segurança poderiam reduzir à exposição aos perigos, como a aquisição de assentos mais ergonômicos, o enclausuramento da capela com luz UV e das autoclaves, a ampliação do uso de EPIs e sinalizações, e um Registro de Incidentes e Acidentes.

Palavras-chave: Saúde e Segurança. Pesquisa Segura. Acidente de Trabalho. Mapa de Risco.

RESUMEN

En las instituciones de enseñanza e investigación, donde existe una gran circulación de investigadores, estudiantes y técnicos, son perceptibles diversos riesgos derivados de la manipulación de materiales biológicos, objetos punzocortantes y/o sustancias químicas, además del uso de distintos equipos de laboratorio. Sin embargo, los estudios sobre riesgos en laboratorios de instituciones de enseñanza e investigación y sus factores asociados son escasos en la literatura científica. En este sentido, este trabajo tuvo como objetivo analizar los riesgos ambientales en el Laboratorio de Microbiología de una Institución de Educación Superior, en Marabá, Pará, Brasil. La investigación empleó el método deductivo, con un enfoque cualitativo, de naturaleza aplicada y procedimiento exploratorio. El método se articuló con el levantamiento de datos bibliográficos y documentales, en el que los datos secundarios se obtuvieron de enlaces especializados y bases de datos de acceso abierto, mientras que los datos primarios se obtuvieron a partir de visitas al laboratorio, durante las cuales se observaron las actividades desarrolladas durante un período de tres meses. Los datos obtenidos indicaron la presencia de los principales grupos de riesgos ambientales en el laboratorio, incluidos riesgos físicos, químicos, biológicos, ergonómicos y de accidentes, presentando algunos de ellos bajo potencial de riesgo. No obstante, los riesgos ergonómicos y de accidentes fueron bastante representativos, principalmente debido a asientos sin respaldo y a la exposición a la luz UV y a las autoclaves, respectivamente. En este sentido, algunas medidas de seguridad podrían reducir la exposición a los peligros, tales como la adquisición de asientos más ergonómicos, el enclausuramiento de la campana con luz UV y de las autoclaves, la ampliación del uso de equipos de protección personal (EPP) y señalizaciones, así como la implementación de un Registro de Incidentes y Accidentes.

Palabras clave: Salud y Seguridad. Investigación Segura. Accidente de Trabajo. Mapa de Riesgos.

1 INTRODUCTION

The trade union movement was responsible for the development of the Risk Map, in Italy, between the 60s and 70s. However, in Brazil, it was only with Ordinance No. 5, of August 17, 1992, by the National Department of Occupational Health and Safety, of the Ministry of Labor, that the implementation in health services became mandatory, being modified by Ordinance No. 25, of December 29, 1994 (Monteiro; Silva; Oliveira, 2015).

The preparation of these risk maps must be done by the Internal Commission for Accident Prevention, as regulated by Regulatory Standard No. 5 (NR-5), in Annex IV. In addition, for the best guidance on how to identify and evaluate occupational exposures, as well as to apply prevention and control measures, NR-9 addresses these topics, which are included in the Risk Management Program (MTE, 2024).

From this perspective, the use of the Risk Map is based on the idea of exposing environmental risks – physical, chemical, ergonomic, accidents, and biological – of the work environment in a didactic way, since this is the employer's duty (Castro; Okawa, 2016). Also according to this author, the employer has a legal obligation to guarantee a service environment designed in such a way as to minimize risks to health and safety, since it is the right to reduce occupational risks through health, hygiene and safety standards.

Health and safety risks are present in various occupational environments, such as industries and companies, and also in the context of teaching and research institutions, where professors, students, researchers and interns are frequently exposed to dangers arising from the handling of biological materials, sharps and chemical substances, as well as the operation of different laboratory equipment. However, studies focused on risk analysis in laboratories of teaching and research institutions, as well as factors associated with hazards, are still scarce in the scientific literature, with greater emphasis on investigations carried out in hospital laboratories (Stehling et al., 2015).

And it is evident that the continuity and increase of research developed in educational institutions need to occur, because they are extremely important in the academic and social environment. This can be explained because scientific surveys and investigations are used as an active methodology in the practice of teaching and learning, and the studies carried out also have practical applications in the social, environmental and economic spheres, since the results found and published promote the dissemination of knowledge to society, especially regarding the explanation and resolution of local problems, a social feedback on public investments in education (Arantes; Peres, 2021).

It turns out that a large portion of the studies developed in educational institutions are carried out in the laboratories of these organizations. Research usually involves the handling of many substances and equipment by researchers, professors, students, and even interns. However, in a considerable part of these institutions there is no tutor with extensive knowledge of the substances, equipment and how to use them, especially a professional available throughout the period necessary to carry out the research, considering that some experiments require hours and hours without interruptions, and inexperienced researchers are unaware of all the occupational risks (Santos et al., 2020).

At the State University of Pará (UEPA), for example, physical-chemical and microbiological research is carried out in the institutional laboratory. Only in one water analysis research did the scholarship holders of the scientific initiation program, advisor professor, laboratory technician and monitor participate in the experiments, and handled vertical autoclave, bacteriological and drying ovens, water bath, laminar flow hood with ultraviolet light, chemical substances (including culture media), and material containing thermotolerant coliforms (Bitencourt et al., 2019). In the environment, there was no identification and didactic exposure of risks.

From this angle, considering the presence of chemical substances, biological agents, laboratory equipment and, not infrequently, the lack of adequate supervision and collective and individual protection measures, it is observed that the environmental risks associated with the laboratories of educational institutions are significant. However, data related to the performance of systematic risk analyses and the elaboration of Risk Maps in these institutions are still scarce.

In view of this, the relevance of the present study is highlighted, both to foster the continuity of teaching and research activities in a safe way — contributing, consequently, to the socio-environmental and economic benefits arising from scientific production — and to ensure the protection of the health and safety of professors, students and other users of the laboratories.

In this context, the intertwining of the study permeates the following questions: What are the working conditions in the institutional teaching and research laboratory? Are teachers and students exposed to dangers related to materials and equipment? What are the possible damages linked to this exposure? Is there any form of health and safety protection, such as the use of protective equipment? And what actions could be implemented for improvements?

Thus, considering that few risk analyses are carried out in laboratories of teaching and research institutions, and that the health and safety of teachers and students can be negatively affected, this research aimed to analyze the basic conditions of the exercise of work activities related to the health and safety of researchers, identify environmental risks, and develop a Risk Map of the Microbiology Laboratory of a Higher Education Institution in Marabá-Pa.

2 METHODOLOGICAL PROCEDURES

2.1 MODALITY OF RESEARCH

The research employed the deductive method (Matias-Pereira, 2016), in which two true premises generate a true conclusion: (1) institutional research spaces have dangers that are little analyzed; (2) the microbiology laboratory is an institutional research space; Then, the risks of the microbiology laboratory can be better analyzed.

The scope of the study was qualitative, because the data obtained related to laboratory risks were demonstrated by the descriptive approach. In addition, the research was also of an applied nature and exploratory procedure (Severino, 2017). The method in question was linked to the survey of bibliographic and documentary data, in the period from 2010 to 2025.

2.2 DATA COLLECTION

Secondary data were obtained from specialized links and from an open access database: Scientific Electronic Library Online (SciELO) and Coordination for the Improvement of Higher Education Personnel (CAPES). The time frame was between 2010 and 2025.

The primary data were obtained by visits to the Microbiology Laboratory of the Higher Education Institution, in which the activities developed for a period of three months were observed, as well as the physical structures, facilities, equipment of the study area and the substances present, in order to adequately characterize the work environment and identify the associated hazards.

3 THEORETICAL FOUNDATION

3.1 ENVIRONMENTAL RISKS

Working conditions, the types of activities carried out in organizations and the psychophysiological issues of employees are factors with a direct influence on the types and degrees of environmental risks in these places, and exposure to risks can lead to accidents with personal and material losses and losses (Rodrigues; Santana, 2010). Environmental risks are classified as physical, chemical, biological, ergonomic and mechanical (Table 1):

Table 1

List of laboratory risks

Physical risks	Physical risks are linked to the forms of energy, the particularities intrinsic to the work environment, as well as the equipment used, such as radiation, pressure, heat, noise and vibration (Rodrigues; Santana; Rodrigues, 2012).
Chemical hazards	Chemical risks refer to any particulates (chemical agents) that have the ability to enter the individual's body through respiration, in the cutaneous form or ingestion, such as smoke, dust, mists, mists and gases, which can remain suspended in the environment (Barros; Morais, 2017).
Biohazards	Biological risks are related to various microorganisms – fungi, bacteria, protozoa, viruses and parasites – and insects, in addition to material from living beings, such as blood and waste (Souza *et al*., 2013).
Ergonomic Hazards	Ergonomic risks arise from man-work relationships, whether due to repetitive movements, accelerated rhythms, long working hours, inadequate postures, monotony, shift work or other forms of physical and psychic pressure, which cause musculoskeletal diseases (Araújo *et al*., 2012).
Mechanical hazards	Mechanical or accident risks are characterized by inappropriate conditions of construction, installations and machinery, which may involve the operation of the company, for example, unprotected equipment, incorrect lighting, situations of possibility of fire and explosion, improper electrical installations and venomous animals (Clemente; Oliveira; Leite, 2017).

Source: Prepared by the authors (2024).

3.2 ENVIRONMENTAL RISKS IN MICROBIOLOGY LABORATORIES

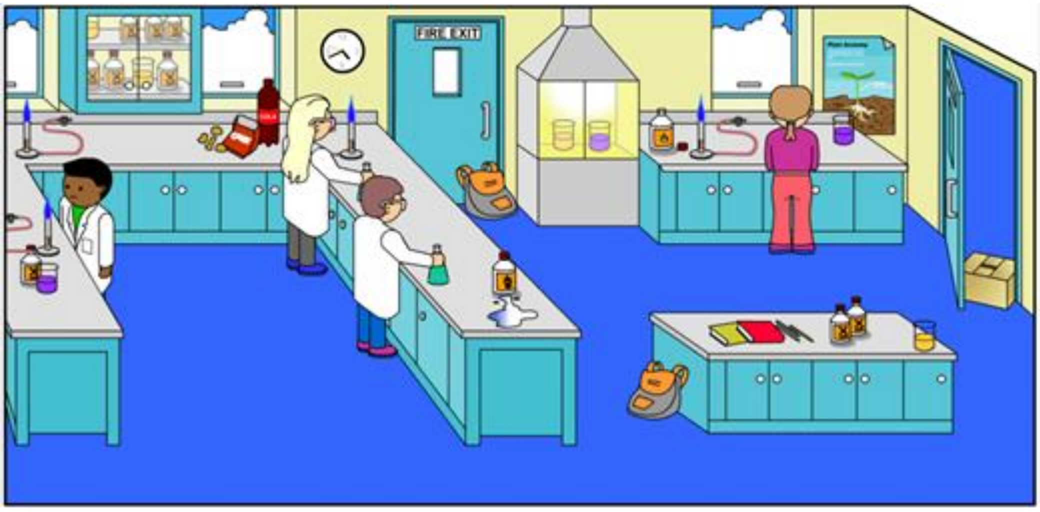
In a basic research laboratory of a higher education institution, all environmental risks are observed, and the users exposed to the risks are professors and students, scientific initiation scholarship holders, master's students, doctoral students, researchers and laboratory technicians, who follow a schedule for the use of the laboratory. Included in the risk analysis are the registration of names and telephone numbers at the entrance, signage for the use of personal protective equipment (PPE), separate room to store personal items, risk symbology, floor, wall and ceiling conditions, electrical installations, lighting, countertops, sinks, standard operating procedure (SOP) of equipment and handling of biological and chemical agents (Vicente et al., 2021).

In microbiology laboratories, the greatest concern is the possibility of exposure to pathogenic microorganisms. Many infections around the world were due to failures in biosafety protocols, both human and environmental structure failures, and caused hundreds of deaths, even by receiving contaminated material from another laboratory. The researchers and collaborators of the institutions, and others exposed in some way, were infected with smallpox, typhoid fever, spotted fever and severe acute respiratory syndrome, a fact that reinforces the lack of personnel training and insufficient supervision of laboratory activities (Câmara; Moreno, 2020).

In addition to microbiological exposure, other risks are also observed in microbiology laboratories, as there is the handling of sharps such as glassware, chemical products, the use of equipment for heating substances, sterilization and drying, such as autoclaves, ovens and laminar flow with ultraviolet (UV) light, in addition to the frequency of inappropriate postures in the exercise of tasks, repetitiveness and long periods in a single position (Figure 1). Therefore, there are risks of: accidents, due to the possibility of fires and explosions, falls and cuts; chemical, by the inspiration and ingestion of particulates; physical, by the heat, radiation and noise of the devices; ergonomic, due to the positions and behaviors of the researchers; and biological, for the reasons presented above (Souza et al., 2021).

Figure 1

Illustration of hazards in laboratories



Source: Exyge (2017).

It is worth mentioning that, in all the risks addressed, the health and safety of researchers can be impaired. A small cut with contaminated glassware can quickly cause severe illness to those exposed, the same can occur in case of inspiration or ingestion of a toxic substance, virus or bacteria. Sterilization equipment such as autoclaves can generate considerable burns, damage to vision (steam), and even cuts, due to the explosion of glassware that suffered thermal shock, for example. UV radiation can cause cellular changes and lead to skin cancer in exposed individuals. And also occupational diseases, which are associated with ergonomics.

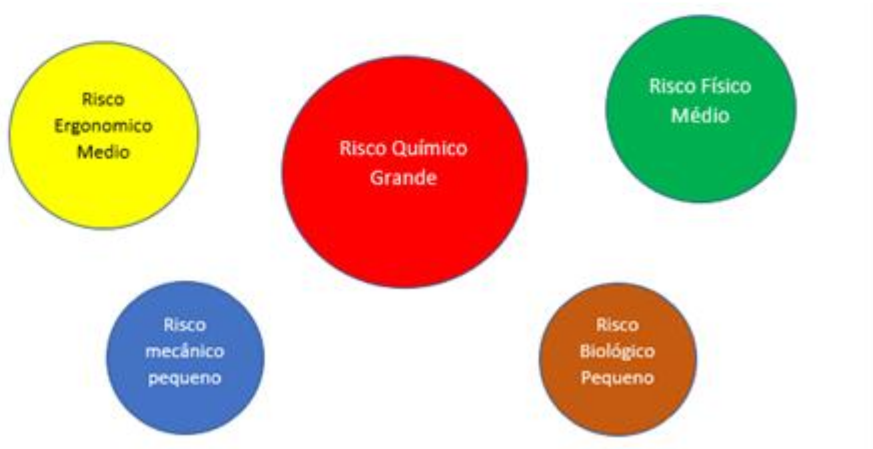
3.3 RISK MAP

It is evident that in environments such as laboratories it is necessary to have didactic information about the risks of the place, such as the risk map. The risk map is the graphic way that gathers information necessary to establish a diagnosis of operational safety and health (OHS), and allows the dissemination of preventive information of an organization (Silva, 2018).

Thus, it takes into account the outline of the floor plan of the site, and exposes the risks perceived in the area by the graph of circles with different diameters and colors (Figure 2), which represent the classification of the grade (small, medium and large) and the group (physical = green; chemical = red; biological = brown; ergonomic = yellow; and accident = blue), respectively (Rodrigues; Santana, 2010). To determine the risk and degree, the working conditions, production process, site structure, machinery, work period, cases of accidents and incidents, and the number of workers exposed to risks are considered (Assmann, 2016).

Figure 2

Graphical model of the classification of environmental risks



Source: Borges (2018).

4 PRESENTATION AND INTERPRETATION OF DATA

4.1 CHARACTERIZATION OF THE MICROBIOLOGY LABORATORY

The laboratory operates during business hours and has a coordinator, three scholarship monitors and a laboratory technician. The coordinator can schedule and authorize the days and times of the formally requested activities, but in some periods he is not present in the enclosure, even because he is a teacher and teaches classes. The monitors have a shorter workload than the laboratory shift, and, therefore, when the coordinator is not present, the operation of the area is interrupted before. The technician is not exclusive to the microbiology laboratory, in fact he is an employee of the chemistry laboratory and assists others who have knowledge.

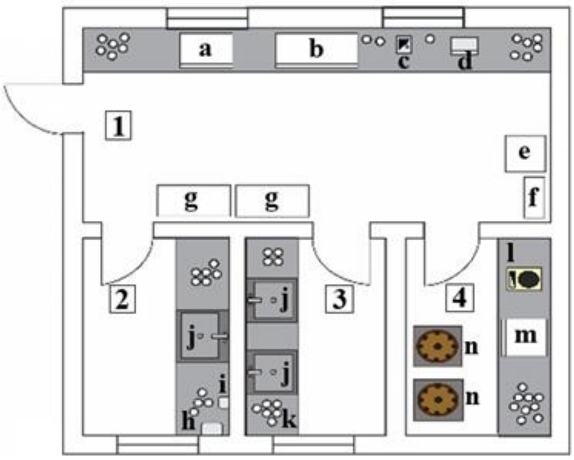
In order to have a better control of the activities developed and responsible, there is a record on the bench, so that all users of the space sign, with name, day and activity performed. Other restrictions are related to food, not allowed inside the place. When the laboratory is used for classes, personal items must also be kept in the room that precedes the place, but cell phones are authorized – a biological hazard (Rivero; Mariano, 2025). Everyone who enters the area must wear closed shoes and lab coats, with clothing of the appropriate length, but there is no signage for the use of PPE. And yet, there is no risk symbology at the entrance, and the equipment manuals are not available to everyone, because they are inside the locked cabinets.

In this context, it is notable that at numerous times the microbiology laboratory does not have a trained supervisor. The project advisors use the environment at different times, including weekends, when they carry out long experiments or do not have other free periods. However, even so, the advisees often develop practical activities without the presence of an experienced responsible person (due to the need to carry out research and meet deadlines), as well as do not always sign the record of activities, or respect the other guidelines, which represents an institutional failure regarding the safety of researchers and the area. for Santos et al. (2020) portrayed that this is one of the main causes of accidents.

The laboratory is subdivided into four rooms, with different functions, for the best development of activities, as follows: 1 – General microbiology room, where the experiments are developed; 2 – Distillation room; 3 – Asepsis room; 4 – Sterilization room. In each area there are materials and/or equipment (Figure 3).

Figure 3

Arrangement of equipment in the microbiology laboratory



Legend: A-sterilization oven; b- laminar flow hood with UV light; c- digital pH meter; d- heating plate; e-refrigerator; f- Cabinet of Substances and Culture Media; g- glassware cabinets and other materials; h- distiller; i- deionizer; J- pias; k- glassware; l- Centrifuge; m- bacteriological greenhouse; n- autoclaves.
Source: Prepared by the authors (2024).

The greatest flow and permanence of people is in the general microbiology room (1), since it is the most spacious and air-conditioned room, in addition to being the only place with benches and benches available for the development of experiments. In addition, a considerable portion of the activities need to be carried out in the chapel, to avoid contamination of the samples. The distillation room (2) is only entered when distilled water is needed for this or other laboratories of the institution. The asepsis room (3) has movement for almost all experiments, whether in washing the glassware before and after the tests, or for cleaning the researchers' hands. The sterilization room (4) is the least comfortable environment, as it is usually the warmest.

Laboratory activities include teaching classes and carrying out research projects. Physicochemical and microbiological analysis of water, analysis of the microbiota of air and soils, or even plants, and investigations into the microbial conditions of materials and environments are some of the themes of the work done in the area. For this reason, due to the exposure and possibility of contact with filamentous fungi and enterobacteria, for example, the indication is that the countertops be decontaminated whenever possible with 70% alcohol - a considerable reducer of microorganisms (Rodrigues et al., 2016), but there is no sign for this. There are also no alcohol and liquid soap dispensers (in the sinks). The waste generated, such as paper and plastic, is disposed of in a common trash can, and the waste from the tests is sterilized and disposed of in a sink.

Regarding the physical structures of the laboratory, the building is made of masonry and located on the ground floor. Water is available in two rooms. There are power outlets in all four rooms. The lighting meets the needs of researchers in all subdivisions of the space. The floor is flat, without elevations and unevenness, and covered in porcelain, for its ease of cleaning and resistance. The walls are clear. The countertops are made of granite, very resistant, with smooth and impermeable surfaces, conducive to laboratory activities (Hussin; Che Lah, 2023). The sinks are made of resistant material, of adequate depth, but without pedal activation. On the roof, despite having a polyvinyl chloride lining (a thermal, acoustic and electrical insulator), leaks were identified in the rainy season.

4.2 HAZARD IDENTIFICATION

Based on the observational visits, considering all the activities perceived, existing equipment, substances handled and the physical structure of the space, the hazards were listed according to the classification of environmental risks and for each room analyzed (Chart 2).

Table 2

Environmental hazards in the areas of the microbiology laboratory

Room	Risk	Danger	Activity/Situation
1	Physical	UV light, heat, cold, humidity and noise	Laminar flow handling, kiln and plate use, central air and gutters
	Chemical	Chemicals, dust, fumes and gases	Handling of culture media, acids, bases, and other liquid and powder substances
	Organic	Fungi and bacteria	Greenhouse and sample handling
	Ergonomic	Long working hours, repetitiveness, monotony and inadequate postures	Preparation of large quantities of tubes and plates for sample analysis, long sitting time on a backless bench
	Accident	Equipment without protection/ signalling, electricity, probability of fire or explosion, glassware	Laminar flow without frontal protection (UV), connection at the wrong voltage, poor maintenance of equipment, lack of masks and gloves, use of sharps
2	Physical	Heat and humidity	Low air circulation, irregular water distillation, leakage and waterlogging
	Organic	Fungi and bacteria	Environment connected to the handling room
	Ergonomic	Repetitive movements, inappropriate postures, monotony and physical exertion	Allocation of bottles to fill over the sink, long time to fill them, and load them later
	Accident	Electricity, probability of fire or explosion	Inadequate electrical installations, poor equipment maintenance, leakage
3	Physical	Humidity and noise	Constant use of water
	Chemical	Chemicals	Cleaning containers with chemicals
	Organic	Fungi and bacteria	Cleaning glassware with analysis material
	Ergonomic	Long working hours, repetitiveness, monotony and inadequate postures	Glassware washing by glassware, long standing time
	Accident	Glassworks	Handling of sharp material, lack of masks, aprons and gloves
4	Physical	Heat and noise	Greenhouse & Autoclaves Handling
	Organic	Fungi and bacteria	Material handling for sterilization and microbial growth in the greenhouse
	Ergonomic	Repetitive movements, inappropriate postures, monotony and physical exertion	Water supply in the autoclaves, disposal and removal of glassware from them, and pressing of the locks on the equipment
	Accident	Equipment without protection/ signalling, electricity, probability of fire or explosion, glassware	Autoclaves without a protective band, lack of thick gloves to handle autoclaves, handling sharps

Source: Prepared by the authors (2024).

The consequences of the researchers' exposure to the dangers analyzed range from photoaging to the possibility of developing skin cancer, in the case of UV light (Tang et al., 2024). In addition to possible burns in autoclaves, which can be serious, especially if the equipment is not well locked (explosion) and is not opened only after the pressure comes out (Milk et al., 2018). Probable cuts in glassware, being very dangerous due to the type and depth of cut, and if the material is contaminated, since microorganisms can reach the bloodstream and organs (Zuo et al., 2023).

Another possibility is the fall of people in the areas flooded by the leaks and leaks (Chew; Asmone; Lam, 2024). Contact with acids, bases, and other substances can be dangerous to the health of researchers, whether contact with the skin (absorption), inspiration (asphyxiation), ingestion, or even splashing in the eyes, with the risk of causing damage to the eyeball (Grace; Sarantopoulos; Horn, 2023). Electric shocks are also likely, especially if there is water nearby, with a possible short circuit (Princeton University, 2026). In addition, forgetting connected appliances can cause fires.

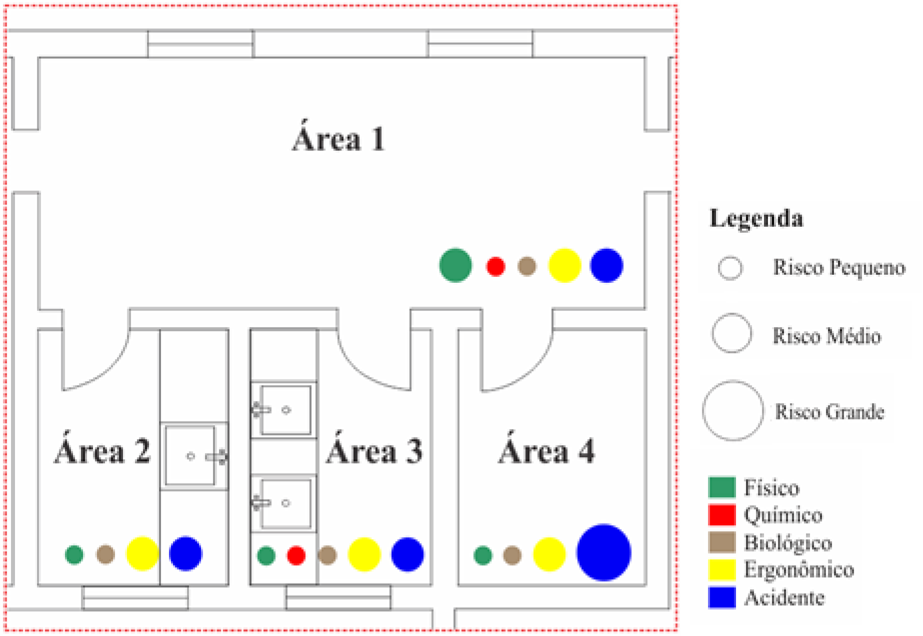
Regarding the posture of the researchers observed in the environments, there is a possibility of back pain, especially such as low back pain and development of deviations in the spine, because individuals spend a lot of time on the benches without backrests, and no matter how much they try to remain in good posture, they get tired and bent. These banks also do not favor the circulation of blood in the legs, because there is not enough support (Fikre et al., 2024).

4.3 MICROBIOLOGY LABORATORY RISK MAP

At this stage, to determine the intensity of the risk and the group, the production process was analyzed, taking into account the structural environment, machinery, work period, cases of accidents, incidents that occurred and the number of workers subjected to these risks (Assmann, 2016). After observing these conditions, the risk map was produced (Figure 4).

Figure 4

Microbiology laboratory risk map



Source: Prepared by the authors (2024).

The flow of people in the laboratory is varied, in research projects it usually involves up to five researchers, but in the teaching of classes the number can reach 30 students. The most dangerous activities are carried out before classes, and students participate only in what is simplest. However, at times it happened that the autoclave was in operation at the time of a practical class. Therefore, considering that the number of people influences the degree of risk, this issue must be remembered.

Physical risk was perceived in all rooms, especially due to heat, cold or humidity, but the lack of Collective Protective Equipment (CPE) or Individual Protective Equipment (PPE) regarding UV light, indicated a higher degree (area 1 - medium), due to more harmful long-term consequences of exposure. The researchers also showed greater discomfort in relation to radiation.

The chemical risk, on the other hand, was observed only in two rooms, in which the glassware used in the experiments is handled and cleaned, and was considered to be of a small degree due to the low probability of accidents, and no incident or nuisance verified.

Regarding the biological risk, it was classified as small, since, in general, the manipulations of microbiological agents are carried out inside the safety hood, and the containers containing colonies of fungi and bacteria are opened only after the sterilization process in an autoclave. However, the occasional absence of continuous supervision during the execution of activities can favor failures in operational procedures, increasing the risk of cross-contamination and dissemination of microorganisms in the laboratory environment.

Ergonomic risk was verified in all subdivisions of the laboratory, to a medium degree, either due to the physical effort required in some tasks, long working hours, or even due to inadequate postures and monotony. The researchers showed discomfort in these situations and complained of pain, when opening and closing the autoclave locks, for example, or when sitting for longer on the benches.

Regarding the risk of accident, it was the only one indicated as large in one of the rooms (area 4). In the use of autoclaves, inexperience was verified by several users, who demonstrated doubts about the correct use of the equipment, such as the amount of water to be supplied before turning on, adequate pressure on the locks and sufficient waiting time to open the locks. More than once someone was burned while handling the autoclaves, and there was an explosion of a Petri dish removed from sterilization, possibly by thermal shock. In addition, it is important to note the possibility of explosion of the device due to improper closure.

5 CONCLUSION

Although half of the risks were considered small, the ergonomic and accident risks were quite representative. Some safety measures could reduce exposure to hazards, enclosing the chapel with UV light and autoclaves would limit access to these equipments, which proved to be more dangerous. The acquisition of other, more ergonomic seats would also be of great value to the protection of the health of researchers. The lack of Personal Protective Equipment is worrying, in the case of handling chemicals and biological material the use of gloves and masks is essential.

In structural terms, repairing the roof is paramount, as is sealing leaks in distillation. In the area there is also a lack of signs, indications of use and dangers, which could be solved with signs, even paper, due to the low cost. The risk map itself can be used in the guidance and prevention of existing risks.

The administrative issue of the laboratory needs to be improved, the control over the use of space is not adequate. There should be training of monitors and researchers, and full supervision of students in practical classes and experimental projects. A document that can help in future actions to prevent accidents is the implementation of the Incident and Accident Record.

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