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THE IMPORTANCE OF ASSESSING OCCUPATIONAL RISKS AND FACTORS THAT COMPROMISE ENVIRONMENTAL COMFORT FOR STUDENTS AND PROFESSIONALS IN THE SCHOOL ENVIRONMENT

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ABSTRACT

The knowledge integration encompassed by occupational safety and its analysis methods has been increasingly used in many different types of organizations. This is due to the importance of obtaining a healthy and safe environment for the collaborator. The current work was carried out in a municipal public school in Presidente Prudente, São Paulo (SP), which serves kindergarten and elementary schools. As an objective, suggestions for improving the work environment are proposed, aiming to provide more comfort and satisfaction with it, in addition to identifying and evaluating the occupational risks to which students and workers in the environment are exposed. To this end, a survey of environmental risks was conducted within the existing risk classifications, and for this, the Preliminary Risk Analysis (PRA) method and the relevance matrix were used. Moreover, issues related to environmental comfort were also verified, analyzing the temperature of the environment and its lighting at strategic points, and comparing them with the values allowed by current legislation. The obtained results verified the true need for interventions and adjustments in the workplace, both because of the presence of occupational risks to which employees and students are exposed and because of higher environmental comfort values than those permitted by law.

Keywords: Preliminary Risk Analysis (APR); Environmental comfort; Workplace safety.

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INTRODUCTION

It is becoming increasingly clear that unfavorable environments can generate great stress at work, causing discomfort for employees and damaging their health.

Therefore, the search for measures to ensure safe and healthy conditions in the workplace is recurrent, especially in the school environment, where employees become directly responsible for the students. Thus, this place's adequacy can improve activities and prevent accidents at work since the prevention of occupational risks can contribute to better professional performance (Dias *et al*., 2020).

In view of this, Seixo (2004) states that, in the school environment, students are exposed to a series of risks, although they are almost always predictable. However, the predictability of accidents may be linked to the large concentration of children and young people in these places when they meet, interact, and practice motor and sporting activities (Seixo, 2004).

In Brazil, even though there are still few scientific studies produced, there is an information gap regarding the accidents that occur in schools and the risks imposed. Therefore, studies focusing specifically on them are valuable because they occur frequently and cause losses to students, employees, and parents (Gurski & David, 2015; Andrade & Oliveira, 2005).

Given the above and knowing that these risk situations may be directly related to the increased risk of accidents (Iida and Guimarães, 2018), Regulatory Standard No. 9 (NR9) considers some occupational risks that managers should constantly check (NR9, 2014), as well as offering environmental comfort guidelines, presented by the Occupational Hygiene Standard No. 11 (NHO11) (NHO, 2018), and using the parameter values presented in the ABNT NBR ISO/CIE 8995-1 standard, which deals with the verification of indoor lighting (ISO/CIE, 2013).

Therefore, this study focuses on analyzing the workers' work activities in a publicly run school with students in kindergarten through the fifth grade. Thus, throughout the work, we sought to answer these questions: what are the main risks related to the work to which the employees of a kindergarten and elementary school are subjected, and how can these risks be eliminated or minimized?

At this point, it is important to highlight that although several studies encompass ergonomic aspects exclusive to the internal classroom environment, dealing with postural and health issues only for teachers and students and their relations with specific furniture in that theoretical learning space, the studies involving the entire school unit and encompassing all its employees are rare.

Therefore, this work may contribute to society as a starting point for future studies to develop a safe and healthy environment for those who dedicate themselves every day to providing an ideal environment for children and adolescents who spend a large part of their lives in intellectual and personal development at school.

Given the above, this study assesses the risks related to the work of the employees of a public school for kindergarten and elementary school. For this, the following specific objectives were proposed: a) conducting the APR to identify occupational risks with the establishment of priorities; b) elaborating the risk map of the school unit; c) measuring the aspects of environmental comfort: luminosity and temperature; d) elaborating suggestions for improvement proposals for the main problems found in the analyses and observations carried out.

METHOD

Study area

The environment in which the present research was conducted is a school unit (**Figure 1**) located in the municipality of Presidente Prudente, São Paulo (SP), which started its activities on March 3, 2004.

Currently, the school unit serves approximately 330 students in the regular period, ranging in age from 4 to 11. Currently, the unit has 25 employees, including three kindergarten teachers who work at the pre-school level, ten teachers who work from the 1st to the 5th grade of elementary school, and a support staff that includes four employees from the general services team, three cooks, one janitor, one principal, one pedagogical counselor, one clerk, and one articulator teacher.

Besides the 25 employees, other workers work on specific activities and attend the school daily, such as interns, itinerant teachers who attend special education, and teachers from the Comprehensive Education Program, Cidadescola.

STUDY METHODOLOGY

The survey of environmental risks in each work sector of the school consisted of a) determining and locating the main sources of risk; b) identifying the possible paths and means of propagation of the agents in the work environment; c) recognizing the functions and analyzing the numbers of workers exposed; d) characterizing the activities and the type of exposure; and e) identifying possible damage to health related to the risks involved.

Figure 1. School facade
Source: The authors (2022)

The quantification of environmental risks influencing the aspects of environmental comfort in the studied environment was performed using specific measuring instruments to measure the level of exposure to which workers are exposed, such as light and temperature intensity. After this step, the results were compared with the acceptance parameters described in specific NRs and NHOs to help with the improvement proposals.

The sectors chosen for the measurements were as follows: the kitchen, due to its specific activities; the kindergarten and elementary school classrooms, where teachers develop their work tasks and are thus exposed to several types of situations that require evaluations; and, finally, the school office, the administrative area where parents and students are attended and where documents, letters, and other activities are processed.

All devices used for measurements were provided by the Universidade do Oeste Paulista (UNOESTE). The collections were performed between September and October 2019 on different days and times due to the activities performed in the various sectors.

For the luminosity verifications, we used the NHO-11 guidelines, the recommendation for the choice of measuring points for the due calculations, and the parameter values presented in the ABNT NBR ISO/CIE 8995-1 standard, which deals with the verification of indoor lighting (Equation 1). For these measurements, we used a Minipa lux meter, model MLM-1011 (**Figure 2**), and the illuminance calculation for indoor work environments established by the Occupational Hygiene Standard (NHO) 11 (2018).

Regarding collecting temperature data from the chosen environments, we used a Minipa digital thermo-hygrometer, model MTH-1362 (**Figure 3**). Data collection occurred at specific points chosen according to the spaces where the professionals involved in each environment develop their activities since the standard needs to be more specific about determining measuring points.

Data collections regarding temperature were performed between September 17 and 20, 2019, in each environment described and at different times.

The following steps were performed to obtain the study's results: Initially, a bibliographic review of the main concepts and relevant works was carried out to understand the subjects to be addressed. After this step, the APR was built for each school sector, where the analyzed risks and their classifications and adequacy proposals would be included. Next, the measurement of the ambient light and temperature indexes at the chosen locations was carried out.

With the survey of the previous information and the data obtained, it was possible to draw up a risk map of the site and, ultimately, provide proposals for preventive and control measures to minimize the risks found and avoid possible accidents arising from these risks.

It is noteworthy that the possibility of certain accidents was considered for the size definition of the circles represented in the risk map. In case of confirmation, the severity would be calculated, i.e., the level of consequence for the individuals suffering the accident. Regarding the colors, we used the standard recognized by NR: blue, mechanical risk;

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Figure 2. lux meter
Source: The authors (2022)

Figure 3. digital thermo-hygrometer
Source: The authors (2022)

yellow, ergonomic risk; green, physical risk; and brown, biological risk (NR 15, 2011).

RESULTS

Risk assessment: external area

The risk assessment started with the school's external areas that employees and students frequent. According to a survey in the school's incident book, this area, followed by the playground, is where most accidents occur.

This result agrees with the research carried out in 20 schools participating in the UNIMED Vida project in the city of Blumenau, which concluded that of the 278 accidents recorded over a year, 41% occurred in the sports court and 29% in the playground. According to the research, the highest incidence of accidents happened during classes in the locations surveyed (55%; Harada *et al*., 2003).

In addition, it was observed that the entire area around the school court has iron grids for water drainage (**Figure 4**), but many of these grids have problems caused by the weather. Many incidents have been reported with employees and students who have tripped, fallen, and injured themselves on these deformities, as it is a passage to enter the court.

Another problem found in the external area relates to the presence of urban pigeons (**Figure 5**) that make their nests on the roof of the court and whose feces dirty several spots that need cleaning almost daily.

The unit's management reported that the municipality recently contracted a company to control pigeon infestations in municipal schools; moreover, the alternatives implemented by the contracted company still need to put an end to the infestation. Initially, sound systems were installed to keep the pigeons away, and later, the pigeon-repellent gel was used on all the roofing hardware. Neither measure was efficient, leaving this problem unsolved until the present moment.

It is worth noting that pigeon droppings cause various issues, the most serious of which is the presence of pathogenic microorganisms and parasites in these birds' excrement. It is important to remember that these droppings can cause diseases and that human infection can occur through the respiratory system (Sarmento *et al.*, 2019).

The school unit was built bordering a preservation area and completely divided by a fence. Thus, there are constant reports about the presence of poisonous animals, such as snakes, spiders, and scorpions, and other wild animals, such as opossums and teiú, which often appear circulating in the internal areas of the school unit.

The existing equipment in the unit, which is the Collective Protection Equipment (CPE), are the fire extinguishers, which are placed in some points around the school (reception, kitchen, library, cafeteria, and hallways near the classrooms), and a fire hydrant in each corridor of the Elementary School (**Figure 6**). The maintenance of the extinguishers is performed within the correct deadlines, and they are properly sealed, ensuring that their use is efficient when necessary.

In general, observing the school's external environment, some structural deficiencies were noticed that directly affect the routine of those involved within the school environment and may negatively influence their physical integrity and cause damage to their health.

The most relevant risk factors involving the external areas of the school unit are represented in the APR (**Chart 1**) and the risk control measures.

Kitchen

Great visual pollution was noticed in the kitchen, with many objects scattered around due to a lack of space. A wall divides the kitchen and the access counters for serving meals, but they are not used for this purpose because the meals are served in the thermal cart or on a table in the cafeteria so that students can serve themselves independently.

Poor lighting was identified because one of the lamps is above the exhaust hood, blocking the lighting in much of the same working space as the cooks. There they would need good lighting for the good progress of the activities and the reduction of visual fatigue during service hours (**Figure 6**). The PRA performed in the kitchen is detailed in **Chart 2**, where the various existing risks are grouped according to the NR 9 risk classification.

Figure 4. Riscos encontrados na área externa
Source: The authors (2022)

Figure 5. Presence of urban pigeons
Source: The authors (2022)

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PRELIMINARY RISK ANALYSIS							
Origin: External area		**No. of exposed employees: All**					**APR No. 01**
Risk/hazard identification				**Risk Assessment**			
Risk	Generating source	Possible Consequences	Risk Class	F	S	R	Prevention, correction, and control measures
Heat	School open spaces with few trees	Dizziness, fainting	Physical	3	2	6	Planting trees between the classroom blocks and around the playground
Pigeon droppings	Presence of pigeon nests	Several diseases that can cause death	Biological	3	5	15	Installation of nursery screen on the court cover
Probability of Fire	Dry vegetation	Burns, suffocation, death, property damage	Accident	2	5	10	Maintenance of vegetation, permanence of fire extinguishers and hydrants in visible locations and construction of barrier around the unit
Bites and injuries caused by animals	Presence of insects and poisonous and wild animals	Allergic reaction, stings, bruises	Accident	4	2	8	Deterrence, wall construction around the unit
Falls	Stairway to the main entrance	Cut, abrasions, fractures, death	Accident	4	5	20	Insertion of a central handrail

Chart 1. PRA of the external area
Source: The authors (2022)

The results presented in the kitchen PRA of the school unit were evaluated to confirm the similarities cited in the study developed by Lopes *et al*. (2019). The study concluded that ergonomic problems were representative of the environment; there were unacceptable working conditions and physical arrangements and high physical, psychological, and cognitive demands. In addition, there were work cycles with excessive volume, many hours of standing, the adoption of extreme postures, and an excessive number of constant movements and displacements.

Classroom

Observations were made on alternate days at different times, and informal conversations were held with the teachers of both modalities at the school.

With the professionals mentioned, the main problems they felt concerning the type of activity and tasks involved in the daily life of a teacher in the classroom were raised. In this conversation, we noticed similarities in the aspects of discomfort and risks found in both modalities, regarding the aspects of environmental comfort, such as temperature, ergonomic risks for the teachers, and accidents due to the furniture in the environments.

Initially, through observations, there were ergonomic problems and a risk of accidents due to the furniture that was visibly inadequate, such as the teacher's chair with crooked legs.

There is also the problem of cabinets storing various materials and toys used by the children. Some of these cabinets are old and at risk of falling and accumulating materials (**Figure 7**).

In conversations with the teachers about comfort in the environment, they reported noise as the most uncomfortable because the classrooms for early childhood education are next to the sports court. This often forces them to close windows and curtains, preventing the entry of natural light and making the environment warmer and stuffier.

Chart 3 presents the PRA of the classrooms, contemplating the risks found.

Secretariat

In this place, we saw that the lighting was deficient. The employee's work is almost entirely performed by the computer, whose screen faces the luminosity coming from the window, reflecting on the screen in a way that, according

Figure 6. kitchen analysis
Source: The authors (2022)

Figure 7. Disorganized materials and old cabinets
Source: The authors (2022)

to the clerk, causes visual fatigue and stress (**Figure 8**). The office's PRA can be seen in **Chart 4**.

Kitchen lighting

Figure 9 shows the collection points instructed by NHO-11. The data were collected in the kitchen on four consecutive mornings between 8 a.m. and 11 a.m.

This time of day was chosen because, according to the cooks, these are the busiest times of the day due to the lunch hours of the classes, requiring more attention to the tasks. The collection was performed between October 21 and 24, 2019, and the values are presented in **Table 1**.

According to standard NHO-11 (2018), it is recommended that the illuminance measured point by point in the areas where tasks are performed should be at least 70% of the average illuminance. Therefore, considering the result obtained, 70% of (*I*) is equivalent to 149.57 lux, i.e., none of the points measured had a value equal to or lower than this.

The standard NBR ISO/CIE 8995-1: 2013 recommends that the illuminance values for environments such as the kitchen should be 500 lux. Thus, the necessary changes should be made to improve the brightness level, offering comfort and safety to the cooks working in that space and increasing satisfaction and productivity.

According to Medeiros (2021), the risks related to workers' health in kitchens can be considered a problem. Besides being an important means of food contamination, these risks expose employees, resulting in consequences for them.

In addition, it is worth noting that a study conducted in food and nutrition units concluded that most employees felt uncomfortable with the heat of the place, which entailed a decrease in work performance, according to Silva, Drumond, and Quintão (2016).

Classroom luminosity

A kindergarten and elementary school classrooms were chosen for the data collection on classroom brightness to

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PRELIMINARY RISK ANALYSIS							
Origin: Kitchen		**Number of exposed employees: 03**					**PRA No. 01**
Risk/hazard identification				**Risk Assessment**			
Risk	Generating source	Possible consequences	Risk class	F	S	R	Prevention, correction, and control measures
Cold/Heat	Alternating activities between stove and refrigerator/freezer	Thermal shock	Physical	1	3	3	Take turns with the cooks so that the person performing tasks in the oven and stove does not have access to a cold area
Fire and Counter	Food preparation on the stove and use of sharp utensils	Burns and cuts	Physical	3	2	6	Adapt the environment so that there is more space around the stove, caution handling sharp utensils, and a quiet environment to perform the tasks
Compound substances or chemicals in general	Cleaning and disinfecting the environment and materials	Respiratory diseases, skin diseases, poisoning, allergies or dermatitis	Chemical	3	2	6	PPE use (gloves, masks, boots, and aprons) to avoid contact of body parts with the chemicals
Manual weight lifting and transportation	Carrying pile of glass plates to the cafeteria; lifting large pots	Back, shoulder, arm pains	Ergonomic	5	2	10	Replacing glass plates with stainless steel plates, which are lighter and more hygienic.
Other situations that cause physical and/or psychological stress	Intense pacing in short intervals	Stress, body aches	Ergonomic	4	2	8	Increased cafeteria space may result in fewer playgrounds
Improper posture requirement	Improper tank height	Back and shoulder pain	Ergonomic	5	3	15	Adequacy of tap height and depth of the tank or replacement of
Improper physical arrangement	Small physical space	Clashes between employees and furniture	Accident	4	2	8	Adaptation of the architectural project with the elimination of the wall and the installation of cabinets and drawers for utensil storage
Probability of fire or explosion	Stove leaking gas or if the valve is kept open by forgetfulness	Burns, suffocation, and death	Accident	1	5	10	Preventive maintenance of the stove/oven and gas outlet pressure control
Improper lighting	Ill-disposed and barred light bulbs	Eyestrain, stress, lack of attention	Accident	2	2	4	Installation of more and higher power LED lamps
Falls	Slippery floor	Cutting, abrasions, fractures, and death	Accident	2	3	6	Use of specific PPEs (rubber boots)

Chart 2. Kitchen PRA

Source: The authors (2022)

PRELIMINARY RISK ANALYSIS							
Source: Early Childhood Education Classroom		**Number of exposed employees: 01**					**PRA NO. 03**
Risk/Hazard Identification				**Risk Assessment**			
Risk	Generating source	Possible Consequences	Risk Class	F	S	R	Prevention, correction, and control measures
Excessive noise	Side conversations during class, outside noise in hallways and court	Stress, Noise-Induced Hearing Loss, tinnitus, anxiety, attention deviation, anxiety, loss of vocal ability	Physical	4	2	8	A noise awareness program and adaptations in the architecture of the environment for acoustic insulation
Heat	Small space with many children	Malaise, fainting	Physical	4	2	8	Installation of proper air conditioning
Agglomeration of people	Children too close together	Proliferation of virus--borne diseases	Biological	5	2	10	School hygiene program and awareness of contagious diseases
Inadequate postures	Inadequate furniture for teachers and students	Back and shoulder pain	Ergonomic	4	2	8	Provision of adequate and new furniture for teacher use
Objects dropping from high places	Old closets with many toys piled up	Wounds, injuries	Accidents	4	3	12	Built-in closets on the lowest level
Poor lighting	Burnt-out light bulbs and other low-power bulbs	Visual fatigue, stress, inattention	Accidents	4	2	8	Adjustment of light bulbs and use of natural light
Bites and injuries caused by animals	The presence of insects and poisonous and wild animals	Allergic reaction, stings, bruises	Accidents	4	3	12	Dedication, building a barrier around the unit

Chart 3. Classroom PRA
Source: The authors (2022)

Figure 8. Secretariat
Source: The authors (2022)

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PRELIMINARY RISK ANALYSIS							
Source: Secretariat			Number of exposed employees: 04			PRA NO. 05	
Risk/Hazard Identification				Risk Assessment			
Risk	Generating source	Possible Consequences	Risk Class/ Category	F	S	R	Prevention, correction, and control measures
Heat	High temperatures and non-air-conditioned rooms	Malaise, fainting, stress	Physical	4	2	8	Proper air conditioning installation
Noises	Outside noise in hallways and courtyard, fans, telephone, and intercom	Stress, Noise-Induced Hearing Loss, tinnitus, anxiety, attention deviation, and loss of vocal ability	Physical	4	2	8	A noise awareness program and adaptations in the architecture of the environment for acoustic insulation
Public attendance	Parents and Students	Proliferation of virus-borne diseases	Biological	5	2	10	School hygiene and communicable disease awareness program
Improper postures and movements	Incompatible chairs and table height and inefficient layout	Back pain (low back pain), RSI, shoulder pain	Ergonomic	4	2	8	Furniture replacement and layout adaptation to the activities that are developed
Poor lighting	Few bulbs	Visual fatigue, stress, inattention	Accidents	4	2	8	Adaptation of the lamps to artificial lighting or use of natural light allied to the layout adequacy

Chart 4. Secretariat PRA

Source: The authors (2022).

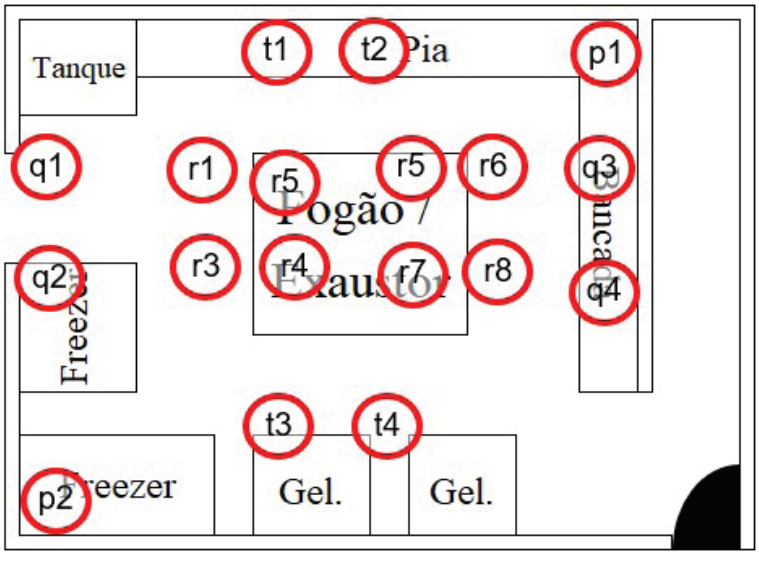

Figure 9. Points analyzed in the kitchen

Legend: Tank; Sink; Freezer (2X); Stove/Exhaust Fan; Countertop; Gel (2X)

Source: The authors (2022)

Table 1. Results obtained at the measurement points

Score	Results (lux)	Average	Score	Results (lux)	Average
p1	236	**216.5 (P)**	**r1**	204	**184.25 (R)**
p2	197		**r2**	194	
t1	244	**212.75 (T)**	**r3**	178	
t2	218		**r4**	154	
t3	186		**r5**	185	
t4	203		**r6**	199	
q1	178	**191.25 (Q)**	**r7**	159	
q2	189		**r8**	201	
q3	211				
q4	187				

Source: The authors (2022)

represent the median situation among what was observed in all the classrooms.

Data was collected to calculate the average illuminance of the kindergarten classrooms between October 21 and 24 between 2:00 p.m. and 2:30 p.m. at the marked points (**Figure 10**). **Table 2** shows the measurement results.

Applying the values obtained from the average luminosity of the measured points, the resulting (*I*) value of 193.75 lux was obtained. Therefore, 70% of (*I*) is equivalent to 135.62 lux, i.e., none of the measured points showed a value equal to or lower than that presented.

However, even if the point-to-point measurement values are compatible with the allowed average illuminance, the standard NBR ISO/CIE 8995-1: 2013 recommends that the illuminance values for classrooms should be 300 lux for primary and secondary schools and 500 lux for evening classes and adult education. Thus, interventions should be carried out to improve the brightness level, providing environmental comfort for developing teachers' and students' activities in the classroom.

Regarding the calculation of the average illuminance of the elementary school rooms, the said collection was performed between 10:00 a.m. and 10:30 a.m. on October 21, 22, 23, and 24, 2019, at the demarcated points, as shown in **Figure 11**. **Table 3** presents the results.

At this point, the resulting value of (*I*) was 310.69 lux. According to the normative recommendation NHO-11, the illuminance measured point by point in the areas where tasks are performed should not be less than 217.48 lux, i.e., the points t3 and t4 measured had lower values than the average illuminance (*I*) found.

As for the value of the average illuminance found in the elementary school room analyzed, it was found to be under the recommendation of the Standard NBR ISO/CIE 8995-1: 2013 on the brightness parameter of 300 lux for classrooms.

It is worth noting that the specific values below the allowed are located at the back of the classroom, where the shelves with materials and fluorescent bulbs do not have the same intensity of white light as the others that the LED model already has replaced are located.

Luminosity: secretariat

In the secretariat, this collection was performed between October 21, 22, 23, and 24, 2019, in the afternoon, between 1 p.m. and 1:30 p.m. It was performed at the demarcated points, as represented in **Figure 12**. The results are presented in **Table 4**.

The secretariat's calculation (*I*) was 162.72 lux. According to the normative recommendation NHO-11, the illuminance measured point to point in the areas of task execution should not be less than 113.9 lux, so the point p2 presented in its average of measurements has a value lower than allowed according to the standard.

Regarding the average illuminance value found in the secretariat, it was found not to comply with the recommendation of Standard NBR ISO/CIE 8995-1:2013 nor with Standard NHO-11 on the luminosity parameter of 300 lux for offices and reception for public attendance.

Given this, it is worth noting that the one-off value below the allowed value is located across from the secretariat's

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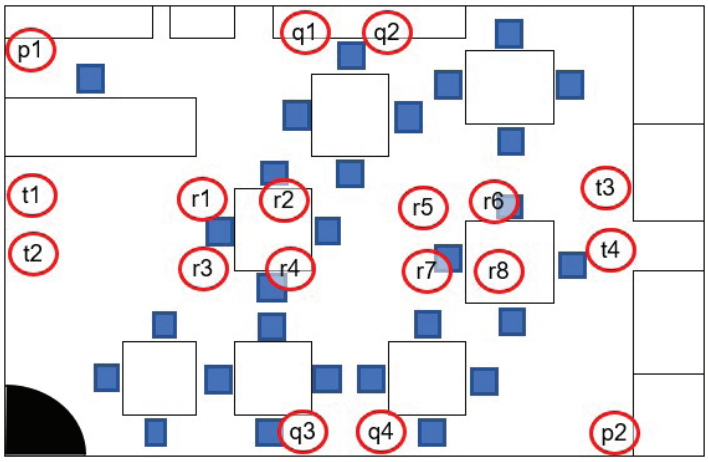

Figure 10. Light measurement points: Kindergarten room
Source: The authors (2022)

Table 2. Results obtained at the measurement points

Score	Results (lux)	Average	Score	Results (lux)	Average
p1	185	178.5 (P)	r1	269	216.125 (R)
p2	172		r2	231	
t1	193	172.75 (T)	r3	254	
t2	202		r4	211	
t3	147		r5	203	
t4	149		r6	196	
q1	202	189.5 (Q)	r7	187	
q2	237		r8	178	
q3	163				
q4	156				

Source: The authors (2022).

entrance door, which is preceded by a windowless corridor with natural light.

It can also be observed that all the points measured near the walls, except for the walls with the windows, obtained lower values due to the bulbs' location since they are located in the central area of the office, even though these bulbs are LEDs with higher white light intensity.

Room temperature analysis: kitchen

The verification of thermal comfort in the kitchen was performed at four different points. The points were chosen based on the statements and observations collected about the places where the cooks spend the most time performing their tasks.

The times described were purposely chosen due to the busy working hours of the kitchen team since it is the students' lunch hours, which are divided into four intervals due to space.

The data were collected on September 17, 18, 19, and 20, 2019, and the following values were obtained (**Table 5**):

Working in industrial kitchens is naturally characterized by higher temperatures than the outside temperature due to equipment such as ovens and stoves. The use of this equipment at certain times, as in the case analyzed

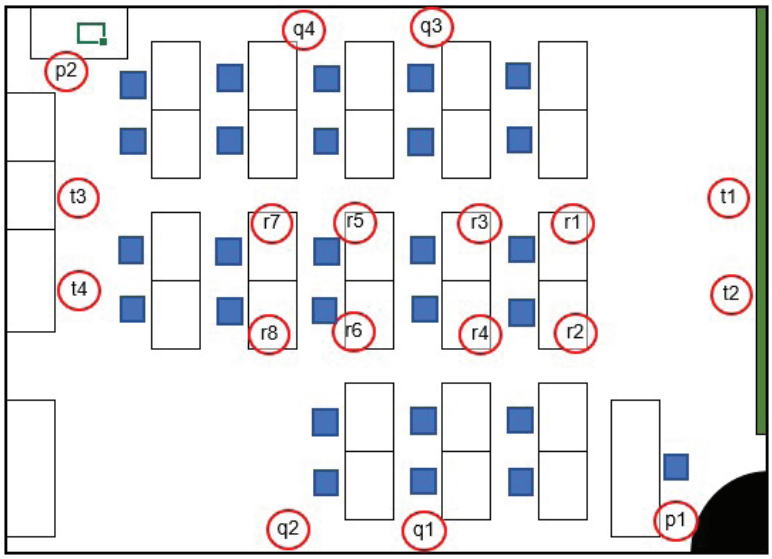

Figure 11. Brightness Gauging Points: Elementary school room
Source: The authors (2022).

Table 3. Average results obtained at the measuring points

Score	Results (lux)	Average	Score	Results (lux)	Average
p1	459	**370.5 (P)**	**r1**	314	
p2	282		**r2**	302	
t1	248		**r3**	344	
t2	290	**236 (T)**	**r4**	370	**324.87 (R)**
t3	194		**r5**	327	
t4	212		**r6**	313	
q1	232		**r7**	318	
q2	270	**299.5 (Q)**	**r8**	311	
q3	350				
q4	346				

Source: The authors (2022)

in this research, when there is a peak of work, shows that the averages were above 34 °C, far above the ideal recommended by NR-17, which establishes that these environments should have an effective temperature between 20 and 23 °C.

It is worth noting that the routines of an industrial kitchen take place in borderline conditions of excessive noise, especially in school environments, heat, humidity, and lighting problems, causing greater human wear and exposing employees to occupational diseases (Pinto *et al*., 2022; Abreu, 2013).

Room temperature analysis: classroom

For the classroom, a kindergarten classroom was chosen. The measurements were performed when students were absent from the classes to avoid jeopardizing the activities' smooth progress. These measurements were taken in the afternoon on September 23, 24, 25, and 26, 2019. The results obtained are described in **Table 6**.

As verified in the readings, even the measurements taken in the morning without students present already showed higher temperatures than those recommended by NR-17.

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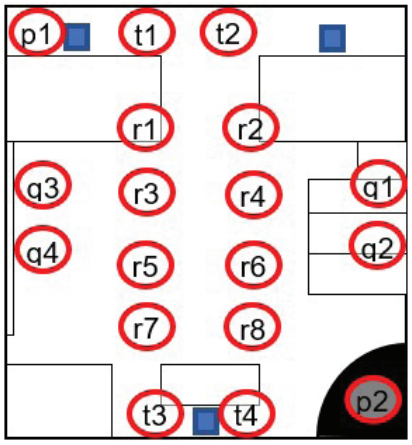

Figure 12. Brightness Gauging Points: secretariat
Source: The authors (2022)

Table 4. Average results obtained in the measuring points

Score	Results (lux)	Average	Score	Results (lux)	Average
p1	176	140.5 (P)	r1	203	181.12 (R)
p2	105		r2	209	
t1	178	196.25 (T)	r3	172	
t2	291		r4	193	
t3	195		r5	173	
t4	121		r6	176	
q1	134	133 (Q)	r7	160	
q2	156		r8	163	
q3	115				
q4	127				

Source: The authors (2022)

Since this environment requires more concentration for the development of the activities of students and teachers, the issue of high temperature brings significant environmental discomfort, bringing negative consequences for both.

According to the observations made and in conversations with teachers and school management, the temperature is a frequent cause of complaint by staff and students. The classroom surroundings receive sunlight directly on their walls, thus increasing the room temperature. In addition, fans break constantly, or electrical problems take a long time to be solved.

Room Temperature Analysis: Secretariat

The measurements were performed on September 17, 18, 19, and 20, 2019 at two different times for thermal comfort evaluation, whose values were described in **Table 7**.

Similar to the measurements of the previous environments, the values found are above the NR-17 recommendations for work environments, which should be between 20 and 23 °C, even in the early hours of the day.

The higher temperatures in work environments directly impact the worker's productivity in their activities, causing stress and triggering a series of consequences for physical and mental health.

School risk map

Based on the observations already presented, it was possible to draw up the General Risk Map of the school unit (**Figure 13**).

Table 5. Results obtained: kitchen temperature

	Results (°C)			
Schedule	**17/09**	**18/09**	**19/09**	**20/09**
10:00 a.m.	35.2	34.5	35.5	35.9
10:20 a.m.	35.8	34.8	35.6	35.9
10:40 a.m.	36.6	34.7	36.3	36.1
11:00 a.m.	36.9	35.0	36.3	36.5
11:20 a.m.	36.5	35.4	36.2	36.6
Average	**36.2**	**34.8**	**36.0**	**36.2**

Source: The authors (2022)

Table 6. Results: Classroom temperature

	Results (°C)			
Schedule	23/09	24/09	25/09	**26/09**
08:40 a.m.	27.5	29.3	30.1	28.9
02:40 p.m.	32.2	33.1	34.3	32.4
Average	**29.8**	**31.2**	**32.2**	**30.6**

Source: The authors (2022)

These findings support those of Nascimento *et al*. (2019), who discovered many ergonomic risks (yellow) on a public school's risk map. These risks strongly indicate that most employees and students are subject to back, arm, or leg pain from staying in the same position for many hours. Moreover, according to the authors, the chairs and tables used by teachers and students were incompatible with the anthropometric measurements of many of them.

Improvement Proposals

For improvements in the kitchen, we highlight the points related to lighting and temperature, which could be alleviated through the repair of the industrial hood - urgently - given that the city has as its main characteristic high temperatures. Consequently, the kitchen environment becomes hotter, so the good functioning of the exhaust hood for heat removal becomes primordial.

Still, it is recommended that the kitchen be reformulated and adapted so that activities can be performed more comfortably because the structure does not allow for easy circulation of external ventilation, making the environment even hotter.

Concerning the classrooms and secretariats evaluated, it is important to install air conditioning in all these spaces because the temperature analyses showed that the ambient temperature in these places is above what is recommended by the legislation in effect, causing consequences in the development of everyone's work.

Still, in relation to temperature, some alternative measures can be implemented, such as planting trees around the school building at specific points on the ground to form a natural barrier to the sun's rays that fall directly on the building's walls. This measure can reduce the temperature and allow windows and doors to remain open because there will be less light reflection.

To reduce the risks of physical and ergonomic accidents, it is initially suggested that a program of education and occupational safety be developed for the staff of teachers, employees, and students, addressing aspects that are present throughout the physical space. Good knowledge of the physical space, such as its limits, deficiencies, and positive points, allows for better clarity in accident prevention. In the event of an occurrence, the program can provide knowledge about the provisions for each case.

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Table 7. Results: secretary temperature

	Results (°C)			
Schedule	17/09	18/09	19/09	20/09
09:00 a.m.	30.5	28.6	29.9	30.8
01:00 p.m.	33.4	32.8	32.9	34.5
Average	36.2	34.8	36.0	36.2

Source: The authors (2022)

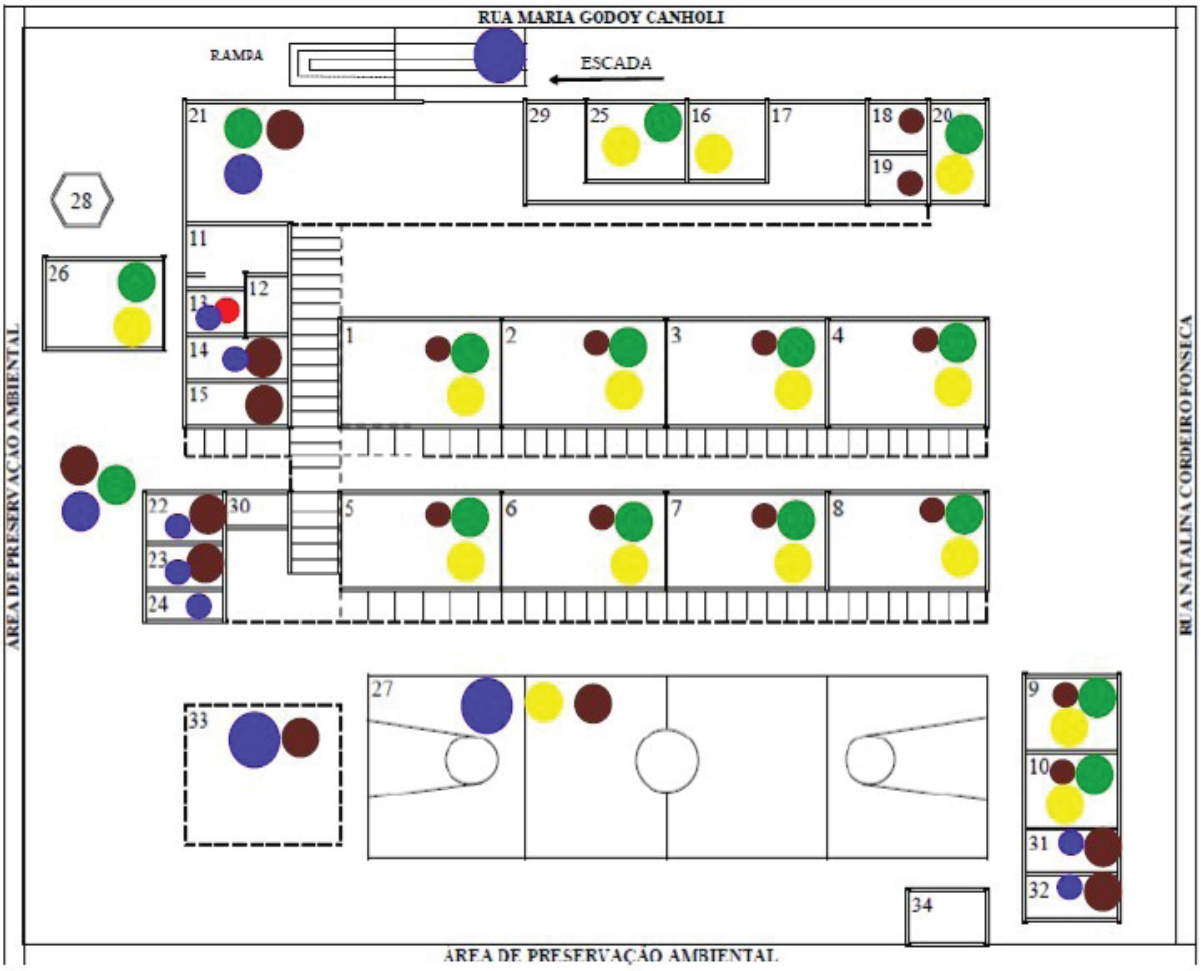

Figure 13. Risk map of the study area

Legend: RUA MARIA GOGOY CANHOLI (Top border); ENVIRONMENTAL PRESERVATION AREA (left vertical border); RUA NATALINO CORDEIRO FONSECA (right vertical border); ENVIRONMENTAL PRESERVATION AREA (bottom border); RAMP; STAIRS

Source: The authors (2022)

Lastly, because this is a public administration institution, the difficulty in acquiring proper and new furniture is well known. However, we cannot ignore that many pieces of furniture and parts of the building's physical structure urgently need to be assessed and corrected to prevent accidents. The corrections include the adaptation of the fencing around the school unit, which has a vegetated area that allows the entry of various wild and venomous animals into the internal area of the school.

CONCLUSION

The use of PRAs and Risk Map allowed concluding that these can serve as a basis for possible improvements by the management and demonstrate in a more didactic and visual way the various risks involving the school sectors.

Regarding the analysis of temperature and light, it was found that there is a need to improve all sectors analyzed, bearing in mind that these factors are extremely important for comfort and are directly related to employees' and students' performance.

In this study, no focus was given to ergonomic problems, but their evaluation is recommended due to the use of non-ergonomic materials and furniture. Moreover, it was found that the site does not have Individual Protection Equipment (IPE) suitable for their respective functions, and this situation is a recommended approach for future studies.

REFERENCES

Abreu, E.S., Spinelli, M.G.N. & Zanardi, A.M.P. (2013), *Gestão de Unidades de Alimentação e Nutrição: um modo de fazer*, 6ª ed, Metha, São Paulo.

Andrade, E.A. dos S. & Oliveira A.R. de C. da S. (2005), 'Acidentes nas escolas: um olhar sobre os procedimentos adotados', n.p., pp. 897-904, disponível em: <https://docplayer.com.br/15552173-Acidentes-nas-escolas-um-olhar-sobre-os-procedimentos-adotados.html> (acesos em: 21 jun. 2022)

Associação Brasileira de Normas Técnicas (1992), *Iluminância de interiores*, NBR 5413, ABNT, Rio de Janeiro.

Associação Brasileira de Normas Técnicas (2013), *Iluminação de ambientes de trabalho*, NBR *ISO/CIE 8995-1*, ABNT, Rio de Janeiro.

Brasil (2011a), Ministério do Trabalho e Emprego, *Comissão Interna de Prevenção de Acidentes*, NR 05, Brasília, Ministério do Trabalho e Emprego.

Brasil (2011b), Ministério do Trabalho e Emprego, *Atividade e Operações Insalubres*, NR 15, Brasília, Ministério do Trabalho e Emprego.

Brasil (2014), Ministério do Trabalho e Emprego, NR09, *Programa de Prevenção de Riscos Ambientais*, Brasília, Ministério do Trabalho e Emprego.

Brasil (2018), Ministério do Trabalho e Emprego, *Norma de Higiene Ocupacional – NHO 11*, NHO 11, Brasília, Ministério do Trabalho e Emprego.

Dias, G.N., Aires, I.O., de Souza, F.R.O., Araújo, M.C., Moura, A.C.C., Lima, S.M.T., Menêzes, J.V.M., da Silva, M.S. & Revoredo, C.M.S. (2020), 'A importância da ergonomia em unidades de alimentação e nutrição: Uma revisão integrativa', *Revista Eletrônica Acervo Saúde*, no. 38, e1680, DOI: <https://doi.org/10.25248/reas.e1680.2020> (acesso em: 21 jun. 2022)

Gurski, C.R. & David, E.L. (2015), 'Conscientização e prevenção de acidentes no ambiente escolar: levantamento de lesões nas escolas do ensino fundamental ii e médio da cidade de união da Vitória-PR', *Uniuv em Revista*, vol 15, no. 1, pp. 247-254, disponível em: <https://periodicos.uniuv.edu.br/uniuvemrevista/article/view/380> (acesso em: 21 jun. 2022)

Harada, M.J., Mattos, P.C.A., Pedroso, G.G., Moreira A.M.M., Guerra, A.B., Silva, C.S., Neves, M.B.P. & Santos, M.L.M. (2003), 'Escolas promotoras de saúde: prevenção de morbidade por causas externas no município de Embu', *Departamento Científico de Saúde Escolar*, p. 57.

Iida, I. & Guimarães, L.B.M. (2018), *Ergonomia: projeto e produção*, 3ª ed, Blucher, São Paulo.

Lopes, S.K., Becker, L.B., Lohmann, A.R. & Amaral, M.N. (2019), 'Ergonomia nos serviços de alimentação: uma revisão integrativa da literatura', *CISaúde: Congresso Internacional em Saúde*, n.p.

Medeiros, M. (2021), *Análise dos riscos ocupacionais em ambiente laboral de manipuladores de alimentos em escolas públicas no Brasil: uma revisão integrativa*, Monografia, Instituto Federal de Educação, Ciência e Tecnologia da Paraíba, Patos, Paraíba.

Nascimento, JC., da Silva, M.R.A., Stano, R.C.M.T., Espanhol-Soares, M., Rodrigues, P.A.A. & Kondo, M.M. (2019), 'O Processo de Elaboração do Mapa de Riscos de uma Escola Pública: Uma Experiência Pedagógica', *Research, Society and Development*, vol. 8, no. 4, pp. 1-20, disponível em: <https://www.redalyc.org/journal/5606/560662195025/560662195025.pdf> (acesso em: 21 jun. 2022)

Pinto, E., da Costa, G.S., Campos, L.D.C. & Thode Filho, S. (2022), 'Elaboração do mapa de riscos para prevenção de acidentes em uma cozinha industrial de uma unidade de alimentação e nutrição hospitalar', *Alimentos: Ciência, Tecnologia e Meio Ambiente*, vol. 2, no. 12, pp. 152-163, disponível em: <https://revistascientificas.ifrj.edu.br/revista/index.php/alimentos/article/view/208> (acesso em: 21 jun. 2022)

Sarmento, K.K.F., da Silva, K.S., Silva, C.B., Lima A.P. & Medeiros, K.M. (2019), 'A presença de agentes patogênicos em fe-

S&G Journal
Volume 17, Number 3, 2022, pp. 327-344
DOI: 10.20985/1980-5160.2022.v17n3.1804

zes de pombos da cidade de Campina Grande-PB', *CONAPESC 2019: Congresso Nacional de Pesquisa e Ensino em Ciências*, Campina Grande, Paraíba.

Seixo, L. (2004), 'Os acidentes em meio escolar: que intervenção?', *Revista Portuguesa de Clínica Geral*, vol. 20, no. 2, pp. 233-242, DOI: <https://doi.org/10.32385/rpmgf.v20i2.10029> (acesso em: 21 jun. 2022)

Silva, K.F., Drumond, N.B. & Quintão, D.F. (2016), 'Avaliação do perfil nutricional e condições de trabalho de colaboradores de unidades de alimentação e nutrição de Eugenópolis (MG)', *Revista Científica da FAMINAS*, vol. 11, no. 2, pp. 34-48.

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