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SURVEY OF RESPIRATORY DISEASES IN THE INTEGRATED MATERNAL AND CHILDREN UNIT OF ECUADOR/ RN, BETWEEN THE YEARS OF 2001 AND 2016.

LEVANTAMENTO DAS DOENÇAS RESPIRATÓRIAS NA UNIDADE MATERNO INFANTIL INTEGRADA DE EQUADOR/ RN, ENTRE OS ANOS DE 2001 E 2016.

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RESUMO

O município de Equador/RN, localizado no semiárido potiguar, apresenta relevante exploração e beneficiamento de caulim. No entanto, essas atividades geram a formação de grandes pilhas de rejeitos que são depositadas de forma aleatória na natureza, contaminando o solo, os corpos hídricos e o ar. Objetiva-se com esse trabalho verificar quais doenças respiratórias são mais frequentes no município, investigando a relação com os rejeitos de caulim. Para tanto, foram selecionados os casos de doenças respiratórias (Broncopneumonia, Bronquite, Asma, Doença Pulmonar Obstrutiva Crônica (DPOC), Insuficiência Respiratória Aguda (IRA), Pneumonia, Pneumoconiose, Silicose, Tumor Pulmonar, Edema Pulmonar e Neoplasia Pulmonar) registrados na Unidade Materno Infantil Integrada de Equador (UMIIE) no período de 2001 a 2015. Os dados associados a essas enfermidades foram: Idade do Paciente, bairro que reside e mês que deu entrada no hospital. A pneumonia foi o diagnóstico mais registrado (134 casos), seguido pela broncopneumonia (107) e asma (59). A silicose apresentou apenas dois casos registrados no período em estudo e o diagnóstico pneumoconiose apresentou três casos. O bairro Centro apresentou mais tipos diferentes dos diagnósticos estudados, que foram DPOC, Edema pulmonar, IRA, Neoplasia pulmonar, e silicose. As crianças entre 0 e 5 anos são as mais acometidas pelos diagnósticos verificados.

Palavras Chave: Mineração, Caulim, Doenças Respiratórias.

ABSTRACT

The municipality of Equador/RN, located in the semi-arid region of the state of Rio Grande do Norte, presents significant exploitation and processing of kaolin. However, these activities generate the formation of large piles of tailings that are deposited randomly in nature, contaminating soil, water bodies and air. The objective of this study is to verify which respiratory diseases are most frequent in the city, investigating the relationship with kaolin rejects. We selected cases of respiratory diseases (Bronchopneumonia, Bronchitis, Asthma, Chronic Obstructive Pulmonary Disease (COPD), Accute breathing insufficiency (ABI), Pneumonia, Pneumoconiosis, Silicosis, Pulmonary Tumor, Pulmonary Edema and Pulmonary Neoplasm) registered in the book of occurrence of the Integrated Maternal and Child Unit of Equador between the years 2001 and 2015. The data associated to these diseases were: Patient's age,

neighborhood residing, and month admitted to the hospital. Pneumonia was the most commonly diagnosed (134 cases), followed by bronchopneumonia (107) and asthma (59). Silicosis presented only two cases recorded in the study period and the pneumoconiosis diagnosis presented three cases. The Centro neighborhood presented more different types of diagnoses studied, which were COPD, pulmonary edema, ABI, pulmonary neoplasia, and silicosis. Children between 0 and 5 years old are the most affected by the diagnoses.
Keywords: Mining, Kaolin, Respiratory Diseases.

INTRODUCTION

Despite the economic importance of mining activities for the localities where they are carried out and for the country's economy, it is worth noting that the way they have been developed, besides representing total disregard for the environment, puts at risk the protection of the people who survive from it due to the hazardous and unhealthy conditions in which many find themselves (Cabral et al., 2012).

The mining and processing industry of kaolin, which produces high amounts of waste, which are discarded without any prior treatment, generates incalculable damages (Menezes et al., 2007), both to the environment and to the local population. This ore is widely used in industry, notably in the production of paper, white ceramics, glass, paints, plastics, fiberglass, cosmetics, pharmaceuticals, food products, pesticides, clarifiers, catalysts for petroleum cracking, among other products (Silva, 2001; Sousa et al., 2007).

Several studies have addressed the issue of pneumoconioses and their effects on workers. Dreessen et al., (1940) investigated the incidence of pneumoconiosis among mica and pegmatite workers. Gao et al., (2001) examined the effects of phospholipid surfactant on the induction of apoptosis by respirable quartz and kaolin in rat pulmonary macrophages NR8383. Chien et al., (2002) conducted a study on pneumoconiosis among workers in a Vietnamese refractory brick facility. In addition, Goelzer and Hanadar (2006) discussed the National Silicosis Elimination Program. These authors discuss the emergence of pneumoconioses, as open-pit mining activities release into the atmosphere dust containing mineral residues, causing lung diseases due to the inhalation of mineral particles. It is noteworthy that underground mining activities also favor the release of dust, since the waste material is often deposited in open pits.

Pneumoconioses (from the Greek, conion = dust) are pathologies related to the inhalation of dust in work environments, excluding neoplastic changes, asthma, bronchitis, and emphysema from this denomination, and therefore gather a set of respiratory diseases known by the main etiological agent, such as silicosis (silica) and asbestosis (asbestos) (Brazil, 2006).

In Brazil, the main pneumoconiosis, from an epidemiological and public health point of view, is silicosis, caused by exposure to dust from free silica or silicon dioxide (SiO_2) in its crystalline form (Algranti, 2001). The physiopathological process begins when the inhaled dust reaches the lung parenchyma, attracting phagocytic and defense cells to the site, causing the release of chemotactic and also fibrogenic substances, initiating the silicotic lesion, consisting of layers of hyaline tissue, which have a reasonable amount of dust (Mossman and Churg, 1998).

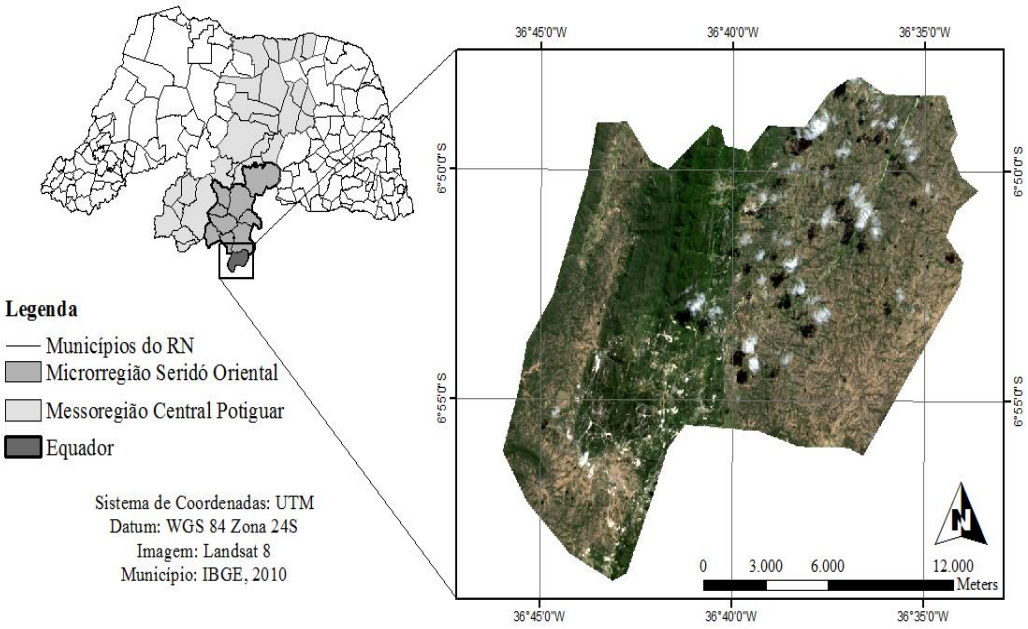
The municipality of Equador/RN, located in the Potiguar semi-arid region, presents a relevant activity of kaolin exploration and processing. However, extraction occurs in a disorderly manner, without exploratory management plans, recovery of degraded areas, and disposal plans for the waste generated after kaolin processing. This waste is often deposited randomly in nature, forming piles of tailings that are subject to wind and water action. These dispersion processes tend to contaminate water bodies, and especially the air with deposited particulate matter, thus, the objective of this work is to verify which respiratory diseases are more frequent in the municipality.

METHODOLOGY

Characterization of the Study Area The study

The study area comprises the municipality of Equador-RN, delimited by the geographical coordinates, latitude 06° 47' 00" to 06° 59' 00" S and longitude 036° 46' 00" to 036° 33' 00" W. With an area of 264,985 km2, it is located in the Central Potiguar Mesoregion, Eastern Seridó Microregion (Figure 1). Approximately 269 km away from Natal, the state capital. It borders the municipality of Parelhas to the north and the state of Paraíba to the south, east, and west.

Figure 1: Location of the Municipality of Ecuador/RN.



Source: Prepared by the author, 2024.

The municipality is inserted into the metallogenic province known as the Pegmatitic Province of Borborema (Scorza, 1944), within the geological context of the Seridó Belt (Jardim de Sá, 1994), represented by lithotypes of the Seridó Group, which is composed of the Equador (NP3s/se) and Seridó (NP3s/se) Formations. Colluvial-eluvial deposits (NQc), as well as rocks from the Serra dos Quintos Complex (PPsq) outcropping in the

extreme west of the municipality, complement the geological framework in the region (CPRM, 2005).

The Seridó Belt comprises a segment of uplifted Precambrian rock folds shaped like domes (Ross, 2003). They are massifs intensely sculpted by erosive processes during the Tertiary, with altitudes ranging from 50 to 800 meters, generally presenting forms with straight or convex tops carved in crystalline lithologies (Bezerra Júnior & Silva, 2007).

The survey conducted by IDEMA in 2008 indicates the predominance of Eutrophic Litholic Soils - poorly developed, shallow, non-hydromorphic, usually stony and/or rocky, moderately to excessively drained, not very thick, gravelly, with predominantly medium texture, and sandy, silty, or clayey textures may also occur. These soils have a small thickness, with frequent occurrence of gravel and rock fragments in their profile, presenting gullies and other forms of erosion (Veloso, 2011). It has a drainage ranging from moderate to pronounced; the water absorbed by the soil is slowly lost but keeps it moist for a short period, favoring erosive processes (Vieira, 1983). These characteristics give this type of soil low agricultural potential due to its shallow depth, reducing the volume of soil available for plant rooting and moisture retention (Bezerra Júnior & Silva, 2007).

Regarding relief, Felipe and Carvalho (1999) highlights:

> It dates back to the Pre-Cambrian, basically comprised of ancient rocks represented predominantly by igneous or magmatic rocks and metamorphic rocks, both of which are commonly called crystalline terrains. This structure occurs in a large part of the State's territory and mainly in the central mesoregion.

A presence and, consequently, extraction of minerals of economic importance such as Clays, Barite, Beryl, Cassiterite, Kaolin, Tantalite, Mica, and Scheelite are attributed to this lithological structure (Bezerra Júnior & Silva, 2007).

In the climatic classification conducted by Valadão et al. (2010) for Seridó/RN based on the Thornthwaite and Mather model, Equador falls into the category DdB'2a', semi-arid mesothermal climate with small or null water surplus, being the municipality in a situation of dry sub-humid, while the others, except for Currais Novos, are classified as semi-arid. With the monthly data obtained from EMPARN, it was also verified that Equador has the lowest annual precipitation total (~ 400 mm) in the micro-region. The rainy season comprises the months from February to June, with annual average temperatures ranging between a maximum of 33.0 °C and a minimum of 21.0 °C (CPRM, 2005).

The Caatinga is the predominant vegetation of the Seridó Oriental micro-region, and it can be subdivided into i) Hyperxerophytic Caatinga - vegetation with a drier character, with abundance of cacti and plants of lower and scattered size, and ii) Subdesert Caatinga of Seridó - the driest vegetation in the state, with shrubs and low trees, sparse and with more pronounced xerophytic characteristics (IDEMA, 2008). Andrade-Lima (1981) characterizes the vegetation of Seridó predominantly as dense or open scrub Caatinga, with individuals formed by trees (around 7 m) scattered in a shrubby matrix. Factors such as soil depth and permeability, frequency, and amount of rainfall interfere with how vegetation is organized and the species that can be found in it (Leal et al., 2003). Therefore, areas with predominance of arboreal or only shrubby vegetation can be found. In these types of vegetation, the most common species are pereiro, faveleiro, facheiro, macambira, xique-xique, and jurema-preta (CPRM, 2005).

The municipality of Equador, according to data from the Project Registry of Groundwater Supply Sources (CPRM, 2005), is entirely within the limits of the Piranhas-Açu hydrographic basin. Its area is bathed by the sub-basins of the rivers Malhada Grande and dos Quintos, with the main water bodies being the dams Mamão (1,183,000m³), Equador (150,000m³), and Riacho Verde (100,000m³). The drainage system follows a dendritic pattern, characterized by watercourses with intermittent flow.

Furthermore, the municipality is inserted both in the Interstitial Hydrogeological Domain and in the Fissural Hydrogeological Domain. The Interstitial Domain is composed of sedimentary rocks of the Colluvial-Eluvial Deposits. In turn, the Fissural Domain encompasses rocks from the crystalline basement, including the sub-domain of metamorphic rocks constituted by the Seridó Formation, Equador Formation, and the Serra dos Quintos Complex, in addition to the sub-domain of igneous rocks of the Granitoids (CPRM, 2005)

Procedural Steps

Cases of respiratory diseases registered at the Integrated Maternal and Child Unit of Equador (UMIIE) from 2001 to 2015 were selected. UMIIE has a medical staff of 10 attending physicians, who provide care in General Medicine and Obstetrics. Regarding the physical structure, the unit has 21 beds for the hospitalization of adults, children, and obstetric cases, a clinical analysis laboratory, and an X-ray room that has been operational since 2003, but, according to the unit's director, constantly malfunctions, failing to meet the demands in the region. The service is not restricted to the population of Equador; residents from the neighboring city of Junco do Seridó-PB frequently seek care at this unit.

Therefore, the following diseases were selected: Bronchopneumonia, Bronchitis, Asthma, Chronic Obstructive Pulmonary Disease (COPD), Acute Respiratory Failure (ARF), Pneumonia, Pneumoconiosis, Silicosis, Lung Tumor, Pulmonary Edema, and Pulmonary Neoplasia. Data associated with these diseases were: Patient's Age, neighborhood of residence, and month of hospital admission; this information was organized into spreadsheets and underwent descriptive analysis.

RESULTS AND DISCUSSION

With the data collected in the municipality, the number of cases per diagnosis and the relationship between diagnosis and age of the patients were verified.

Pneumonia was the most registered diagnosis (134 cases), followed by bronchopneumonia (107) and asthma (59). There were also cases of bronchitis (50), Chronic Obstructive Pulmonary Disease - COPD (34), Pulmonary Edema (1), Acute Respiratory Failure - ARF (11), Pulmonary Neoplasia (1), Pneumoconiosis (3), silicosis (2), Lung Tumor (1), and Pneumopathy (30).

Carneiro et al., (2002) in a study on the occupational health of 300 workers exposed to silica treated on an outpatient basis in Belo Horizonte, found that the most prevalent comorbidities among the researched patients were pneumonia (9.4%) and asthma (5%).

Silicosis had only two cases registered during the study period, and the diagnosis of pneumoconiosis presented three cases. Based on DATAPREV data (2004), it was found that between 1999 and 2002, 46 cases of pneumoconiosis were registered in the

northeastern region (of which 19 were silicosis cases). In Parelhas, in the northern Rio Grande do Norte Seridó region, a neighboring municipality of Equador, Lima (2009) registered 4 cases of silicosis between 1996 and 2006. In Pedra Lavrada, located 48km from the municipality under study, information from the Epidemiological Surveillance Service, linked to the Municipal Health Department of Pedra Lavrada, indicates that 29% of the patients treated at the local Health Unit in 2004 had some respiratory problem, and in the same year, there were three patients with severe silicosis, and up to the year 2004, five people died from this disease (Souza et al., 2009).

However, silicosis, being associated with a series of other morbidities, may distort the record on the death certificate. The Health Department of Pedra Lavrada reports cases of deaths in which silicosis is not recorded on the death certificate, with the cause of death listed as other reasons, such as cardiopulmonary arrest. This lack of awareness may be associated with the lack of a precise diagnosis of the disease, as pointed out by Souza, Navarro, and Dantas (2009).

Silicosis is diagnosed through analysis of chest radiography, which shows the typical pattern of scarring and nodules, and the patient's occupational history (Fagundes and Zanellato, 2009). The International Labour Organization has created a code for radiological changes that quantifies small silicosis nodules into 12 subcategories (ILO, 2005). In Brazil, a case of silicosis is considered when the reading is done by at least three experienced readers, associating the categories proposed by the ILO (Carneiro et al., 2006).

Therefore, it is inferred that the precise diagnosis of this disease is not carried out, as there is no adequate follow-up of the occupational history and no appropriate equipment to accurately diagnose the illness. The municipality of Equador, for example, despite having an X-ray room, has to refer patients in extreme cases to Campina Grande PB for more accurate exams and proper treatment, as the X-ray equipment constantly breaks down. When examining the number of cases of pneumoconiosis (3), the lack of precise diagnosis of pneumopathies is evident.

Avelino (2012), when questioning about the knowledge of silicosis among miners in the municipality of Junco Seridó-PB, found that 83.3% of the interviewed workers did not know about the occurrence of this disease, and 16.7% were not aware of this disease that is so common among them. This lack of awareness, combined with the fear of affected individuals being harmed in mining activities, whether in a company or independently, leads to deficiencies in the records.

Most workers are aware that such activities have the potential to harm their health, but there is a need for training in health services and appropriate equipment for accurate diagnosis (Lima, 2009), as well as public education and oversight by competent authorities regarding occupational safety in mining companies. In addition, other pulmonary pathological conditions can be diagnosed, as silica not only produces silicosis, but its exposure can also result in other pneumopathies, such as COPD, which presented 34 cases in this study.

When the distribution of diagnoses by locality was examined, it was found that bronchopneumonia was most frequent in the Alto da Bela Vista neighborhood; bronchitis in the Dinarte Mariz neighborhood; lung tumors were registered in the Alto do Juazeiro neighborhood; pneumopathies in the Prefeito José Marcelino de Oliveira neighborhood;

COPD, pulmonary edema, acute respiratory failure (ARF), pulmonary neoplasia, and silicosis diagnoses were more frequent in the Centro neighborhood of the municipality.

It was observed that children aged 0 to 5 years are the most affected by the diagnoses identified. For this age group, 23% of bronchopneumonia cases, 24% of bronchitis cases, 64% for ARF, 45% for pneumonia cases, and 44% for pneumopathies cases were registered. Only 1 case of edema (in the age group between 65-70 years), 1 case of neoplasia (in the age group between 45-50 years), and 1 case of lung tumor (in the age group between 10-15 years) were registered. Regarding silicosis, there were only 2 records, corresponding to the age group between 40 and 50 years. The table below presents the percentage of cases by age for the most frequent diagnoses (Table 1).

The age of the child is a relevant factor due to immature physiological functions and an immature respiratory tract (Prietsch et al., 2003). Additionally, low birth weight, malnutrition, lack or short duration of breastfeeding, absence of immunization, indoor air pollution, and low family income, associated with overcrowding, make the child even more susceptible to these diseases (Prato et al., 2014). Respiratory diseases are classified as the leading cause of hospitalizations in the Unified Health System (SUS) and also contribute to the morbidity and mortality rates of children under 5 years of age (Fernandes Neto et al., 2015).

Table 1: Percentage of diagnoses by patient age.

Age class	Frequency of diagnoses according to age class				
	Bronchopneumonia	Bronchitis	Pneumonia	DPOC	Pneumopatia
0-5	22,94%	24,04%	45,19%	5,71%	44,12%
5-10	9,17%	14,42%	5,19%		5,88%
10-15	10,09%	4,81%	3,70%		2,94%
15-20	5,50%	2,88%	4,44%		
20-25	8,26%	3,85%	2,22%		
25-30	3,67%	2,88%	0,74%	5,71%	2,94%
30-35	3,67%		2,96%	2,86%	0,00%
35-40	2,75%	3,85%	4,44%		5,88%
40-45	3,67%	0,96%	2,22%		
45-50	4,59%	0,96%		5,71%	
50-55	0,92%	2,88%	1,48%	2,86%	2,94%
55-60	2,75%	4,81%	3,70%	14,29%	
60-65	4,59%	0,96%	1,48%	2,86%	8,82%
65-70	3,67%	4,81%	2,96%	14,29%	5,88%
70-75	2,75%	6,73%	2,96%	14,29%	

75-80	6,42%	3,85%		14,29%	2,94%
80-85	1,83%	13,46%	7,41%	8,57%	14,71%
85-90	2,75%	2,88%	6,67%	2,86%	
90-95		0,96%	2,22%	5,71%	
95-100					2,94%

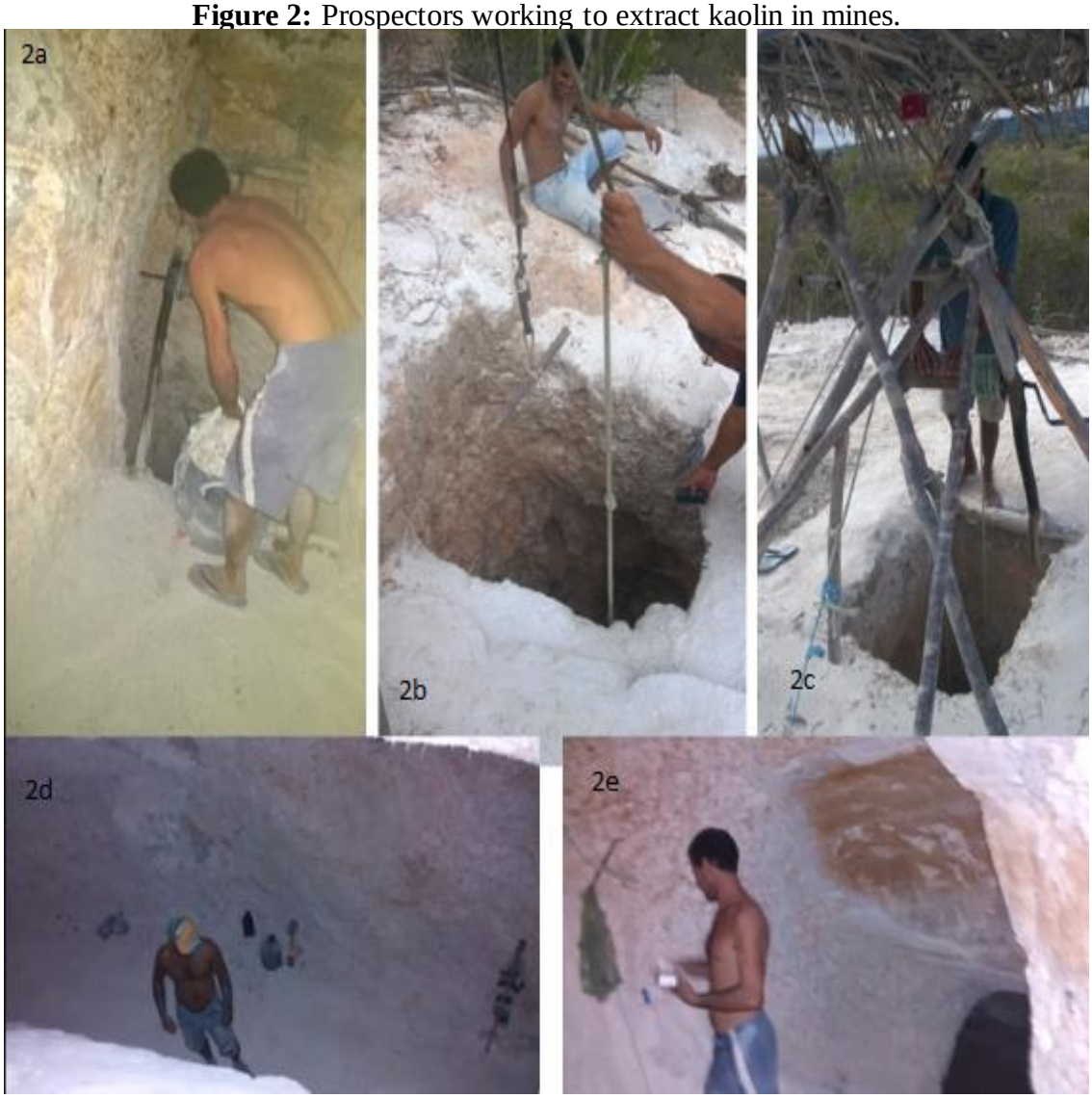
Source: Prepared by the author, 2024.

In studying the environmental impacts caused by the final disposal of mining waste in Junco do Seridó/PB, Fernandes Neto and colleagues found the occurrence of respiratory diseases, both in direct workers with mining activity and in the population living near the extraction areas, due to involuntary inhalation of dust (Sousa and Alchiieri, 2011). Workers in the kaolin mining in Equador do not use any type of PPE and can spend up to 10 hours inside the mines, in direct contact with dust. Figures 2a, 2b, 2c, 2d, and 2e depict the unsafeness of the activity in the municipality.

However, this data was not widely disseminated to the population and to municipal and state managers. Evidence of this is that when information on deaths related to kaolin extraction (such as mine collapses and respiratory diseases) was requested in the studied municipality from the Technical-Scientific Institute of Police of Rio Grande do Norte (ITEP) regional office in Caicó, the response obtained was that they did not have data on deaths from respiratory diseases, only deaths from violent causes. The collected data shows that over a period of 20 years, there were 38 violent deaths in Equador/RN, including 1 by drowning, 1 by beating, 1 by bee sting, 5 homicides, 6 by mine collapses, 7 by undetermined causes, and 17 by traffic accidents.

Another important discussion concerns the data provided by the Regional Sub-coordination of Seridó - ITEP/Caicó-RN. When asking various miners if they knew anyone who had died in the activity inside the mines, the responses exceeded 6 individuals. By the end of the first semester of 2015, the beginning of this research and the first field activity, 3 mine collapses were reported in the region. The accuracy of this data becomes doubtful because the classification is not related to the year of the incident, showing that there are several gaps in this information

Figure 2: Prospectors working to extract kaolin in mines.



Source: Personal collection, 2024.

CONCLUSION

The municipality of Equador has several points of kaolin extraction, some even located within the urban area, in addition to open-air beneficiation waste deposits. However, we cannot categorically state that cases of pneumoconioses in Equador have a direct relationship with mineral-based activities. For a more precise analysis, it is essential to conduct a detailed survey of the occupational history of the population, along with accurate diagnoses of respiratory diseases.

Although the problems resulting from pneumoconioses and their different typologies are well documented in the literature, precise epidemiological information in Brazil is scarce. This can be attributed, in part, to the difficulty in precisely diagnosing these diseases.

Many of them require careful investigation of the patient's occupational history, as well as chest radiographs for accurate disease identification.

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