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Socio-environmental and parasitological aspects of waste pickers in Minas Gerais, Brazil

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ABSTRACT. The increase in the generation of Solid Urban Waste causes social, environmental problems and damages to the population's health. Professionals who work in the collection of recyclable waste are exposed to risks of contamination either by toxic elements or pathogenic organisms. The objective of the work was to estimate the types and prevalence of intestinal parasites in waste pickers. A field research was carried out from December 2017 to April 2018 with the voluntary participation of 26 waste pickers belonging to three associations in the municipality of Conselheiro Lafaiete, Minas Gerais, Brazil (CAAE: nº 79937817.7.0000.8122). In addition to the application a socio-environmental questionnaire, each volunteer provided a stool sample for laboratory testing the parasitological examination. Of the 26 survey participants, four (15.4%) had a positive result and were infected by the parasites *Giardia lamblia*, *Entamoeba coli* and *Iodamoeba butschlii*. Among the main factors that can contribute to the infection these waste pickers are the ingestion of untreated water for consumption in addition to reduced access to Personal Protective Equipment (PPE) during waste management. One way to control the presence of parasites would be through health and environmental education actions, periodic parasitological examinations and permanent use of PPE.

Keywords: contamination; sustainability; solid waste; parasites.

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Introduction

Over the years, an increase in the generation of Solid Urban Waste (SUW) can be noted, and, accompanied by this increase, it is growth visible that, in cities, waste is found to be improperly packaged. We can relate this situation to the inefficiency of urban cleaning management, leading to social, environmental problems and also damage to the health of the population (Gouveia, 2012).

Items classified as SUW are those derived from domestic activities, in addition to urban cleaning waste, which are generated by cleaning streets and public roads (Brasil, 2010).

The Brazilian Association of Companies of Public Cleaning and Special Waste (ABRAELPE) points out that 3,324 municipalities inappropriately dispose the solid waste. In Brazil, around 7 million tons of solid waste per year are not collected or have an improper destination. This scenario results in damage to the health of the population in all regions of the country (Associação Brasileira de Empresas de Limpeza Pública de Resíduos Especiais [Abrelpe], 2016).

Solid wastes such materials, substances, objects, or disposable goods, generated from human actions must have an environmentally correct final destination, that is, guaranteeing their reuse, recycling, composting, and energy use. According the Law N°. 12.305 / 2010 (Brasil, 2010), which institutes the National Solid Waste Policy (NSWP), the selective collection consists of: “[...] collection of solid waste previously segregated according to its constitution or composition” (Brasil, 2010). NSWP foresees the incentive for the development of cooperatives and associations of waste pickers, with the objective of including them socially and economically in society.

In the solid waste chain, recyclable waste pickers are part of the group, who search among the disposable materials for those that can be reused to obtain their income and work (Santos, 2009; Fergutz, Dias, & Mitlin, 2011). Recyclable materials, cardboard, paper, glass, plastic, metal, or any other type of common waste, except food, are considered recyclable.

The waste picker is often seen as part of the problem of social inequality and as a reflection of the excessive production of solid urban waste (SUW) (Castilhos Junior, Ramos, Alves, Forcellini, & Gracioli, 2013). The main factors that lead waste pickers to carry out this work are low qualification, a life history in which their professions were devalued and low education (Moraes, 2009; Binion & Gutberlet, 2012).

Waste management activities carried out by waste pickers are related to several risks to public health, whether due to the composition or the nature of the waste itself. In addition to the exposure of people who work directly with this type of material (Auler, Nakashima, & Cuman, 2014).

In direct or indirect contact during the separation and commercialization of this waste, the waste pickers are exposed daily to the risks of contamination by toxic materials or even pathogenic organisms that may be present in the materials (Santos & Merlini, 2009). Among the diseases that waste pickers can acquire when handling solid waste, there are intestinal parasites that are generally transmitted through eggs, cysts, and parasitic larvae disseminated mainly by food, water, and fecal material (Ribeiro, Freitas, Carvalho, & Oliveira Filho, 2014).

Enteroparasitosis are disease caused by parasites in the human intestinal tract, commonly transmitted via the fecal-oral route, and the occurrence is related to poor hygiene conditions (Andrade, Leite, Rodrigues, & Cesca, 2010; Gil, Busati, Cruz, Santos, & Gomes, 2013). The parasites can trigger a series of damages to the organisms of infected people, from lesions in the tissues, inflammatory reactions, intestinal obstructions, nutritional imbalance, formation of abscesses, and in cases of high parasitic load on the organism, it can lead the patient to death (Santos & Merlini, 2009).

Intestinal parasitosis can be caused by both helminths and protozoa that manifest themselves in the intestines of living beings, causing a series of adverse effects in infected patients. Among helminths, there is a greater occurrence of *Ascaris lumbricoides*, *Trichuris trichiura*, and parasites of the *Ancilostomatidae* family, such as *Necator americanus* and *Ancylostoma duodenalis*. The most common types of protozoa are *Entamoeba histolytica* and *Giardia lamblia* (Neves, 2010; Rey, 2017).

The infected people can be asymptomatic, or have mild to severe symptoms. Severe symptoms can include cases of malnutrition, diarrhea, nausea, vomiting, abdominal pain. Severe conditions depend on the patient having a higher parasitic burden (Andrade et al., 2010).

Considering that, during waste handling, waste pickers may be exposed to the risk of possible contamination within the workplace or during the collection of recycled materials, the present study aimed to identify the types and prevalence of intestinal parasites in waste pickers in addition to describing the types of parasites found; relate socio-environmental factors with the occurrence of parasites, to present viable alternatives for the protection of the waste pickers to reduce direct and indirect contamination, and guide infected waste pickers so that appropriate treatment is carried out.

Material and methods

Contact with waste pickers

The study was handled in the city of Conselheiro Lafaiete, state of Minas Gerais, Brazil, located in the mesoregion of the state capital, Belo Horizonte. In 2019, it estimated about 128,589 inhabitants in the city (Instituto Brasileiro de Geografia e Estatística [IBGE], 2010). In the municipality, there are three associations of recyclable material collectors: Association of waste pickers of Conselheiro Lafaiete (ASCOL), Association of Collectors of Recyclable Products of Conselheiro Lafaiete (ASCOPRE), and Association of Collectors of Recycled Materials of Conselheiro Lafaiete (ASMARCOL).

Before initiating contact with waste pickers associations, in August 2017, the Environment Secretariat of Conselheiro Lafaiete was sought, due to the direct involvement of this sector with the associations. At the first meeting, the research proposal was presented and received full support for it to be implemented. In December 2017, the first contact was made with representatives of the three waste pickers associations of Conselheiro Lafaiete to present the research proposal. On that occasion, it was explained to nineteen present waste pickers, the main objectives of the research, and the methodology of data collection. Subsequently, there was an interest in participating.

The study population consisted of all workers in the 3 associations in 2018, totaling 30 people. However, 26 people participated in the research, considering that two were disconnected from the associations during the execution of the project, one answered the questionnaire, but did not perform the exam and one was not present to deliver the sample.

The project was submitted to the Research Ethics Committee (REC) of Santa Rita Faculty, complying with the requirements contained in the Guidelines and Norms of Research involving Human Beings, which are part of Resolution 466/12. This research was handled respecting the participants and guaranteeing their free and informed expression to contribute and remain or not in the research. For that, at the beginning of the research for each participant, the informed consent form, in order to guarantee the safety of the researched biological information and materials. The project was approved by the Research Ethics Committee in December 2017 (CAAE - 79937817.7.0000.8122).

To collect information regarding the group's life and work routine, a questionnaire was applied. All volunteers were previously helped to answer the questions to reduce the researcher's interference in their answers. Before applying the questionnaire, the informed consent form was presented and all interested parties read and signed it, signing the responsibility to participate in the research and ensuring the confidentiality of the data provided.

Obtaining socio-environmental data and parasitological analysis

In order to deepen the information on the socio-environmental conditions of the workers, before the questionnaires were applied, their work routine was followed, when allowed, in order to bring the parties together and initiate a relationship of trust between the researcher and the researched. Between January and March 2018, two visits were made to each association to monitor and record the activities of workers (Figure 1).



Figure 1. Place for separation of recyclable materials - Conselheiro Lafaiete – MG.

For realization the parasitological exams, we had a partnership with the Queluz LTDA Clinical Analysis Laboratory, in which collection vials were made available, as well as the analysis, issuance and signature of the reports of each participant. The bottles delivered to the waste pickers contained the preservative liquid Merthiolato-Iodo-Formol (MIF), for the conservation of the material and the guidelines for the collection of feces. The delivered samples were stored and transported to the support laboratory in a refrigerated box, as indicated by the standard operating procedure for transporting biological samples (Resolution of the Collegiate Board, Anvisa N°. 302) (Brasil, 2005). The results of parasitological stool examinations as well as questionnaires were organized in tables and graphs and analyzed using descriptive statistics, using the Microsoft Office Excel Software version 2016.

Handling the parasitological test

After the collection of feces, parasitological analyzes were performed at the Clinical Analysis Laboratory which supported the project. The technique used to detect eggs, cysts, and/or larvae of parasites was the HPJ method (Hoffmann, Pons, Janer) by spontaneous sedimentation (Neves, 2010).

To perform the spontaneous sedimentation method, the feces were first diluted by the preservative liquid itself and, later, homogenized with a glass stick. The suspension was transferred to the conical cup to be filtered with gauze. The material present in the gauze was discarded and water was added to this dilution until completing the conical cup so that eggs, cysts, and or larvae could settle. After two hours, the supernatant was discarded, leaving only the sediment. With the aid of a Pasteur pipette, the sediment was transferred to a slide, a drop of lugol was added and a coverslip was placed on top of the mixture to perform the slide reading under the microscope.

After the microscopic analysis of the samples, the laboratory report was prepared and the results were delivered in secret to each waste picker. Volunteers with a positive diagnosis for parasitosis were advised to look for a health post for a doctor evaluation. During the delivery of the results, guidance was given to workers on the general forms of transmissions and preventions along with the importance of using safety equipment, which can prevent contamination, when there is direct contact with food, underwear.

A lecture was held in one of the associations on the importance of the correct use of Personal Protective Equipment (PPE's) during work, to reduce accidents at work and also prevent them from possible contamination. The activity was carried out in November 2018, by students from the Production Engineering course at Santa Rita Faculty.

Results and discussions

Of the twenty-six volunteers who participated in the research, there was a higher prevalence of female waste pickers (73%) compared to men (27%), possibly because women work, most of the time, to supplement family income (Figure 2).

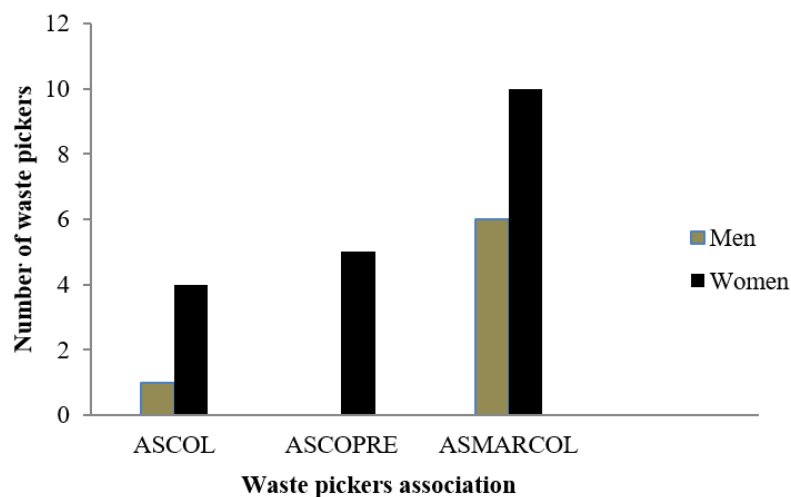


Figure 2. Total of waste pickers participating in the survey by association of recyclable material and by sex (n = 26).

Contrary to what was verified in the municipality of Conselheiro Lafaiete, Minas Gerais, in a study handle in the municipality of Pelotas, the author found that 80.30% (53) of the waste pickers were men and 19.70% (13) women, who, in general, do not work outside from home because they perform other unpaid functions, such as care for the home and family (Valente, Silva, & Xavier, 2016).

Regarding contamination by intestinal parasites, from the 26 participants in the study, four (15.4%), presented positive results for the parasitological examination of feces. For the others, 22 workers (84.6%), the samples analyzed were negative for the search for parasites in feces. Two people were infected by the parasite *Giardia lamblia*, one by *Entamoeba coli*, and one by *Iodamoeba butschilii*, all species of parasites belonging to the group of protozoa. Ribeiro et al. (2014) in a study carried out in the city of Pelotas, RS, found seven (70%) positive cases of parasitosis in 10 waste pickers, with contamination by *Entamoeba coli* protozoa being recorded in three waste pickers.

The main routes of contamination by *Iodamoeba butschlii*, *Entamoeba coli*, and *Giardia lamblia* happen through the ingestion of mature cysts contained in food and also by untreated water. *Iodamoeba butschlii* and *Entamoeba coli* can also be considered non-pathogenic because they are part of the intestinal flora of humans (Table 1) (Pereira, Atwill, & Barbosa, 2007; Neves, 2010).

Table 1. Prevalence of parasites in waste pickers, parasitic species and transmission route.

Number of people infected by Association	Parasite found	Possible route of contamination	Literature information
Two people (7%)	<i>Giardia lamblia</i>	Contaminated water and food	Neves, 2010 Ribeiro et al., 2014
One person (3%)	<i>Entamoeba coli</i>	Contaminated water and food	Neves, 2010 Ribeiro et al., 2014
One person(3%)	<i>Iodamoeba butschlii</i>	Contaminated water and food	Neves, 2010 Ribeiro et al., 2014

The contamination by *Giardia lamblia* has as a common symptom of liquid and increased evacuation, malaise, abdominal pain, weakness, and weight loss. It can still occur, but infrequently, loss of appetite, nausea, vomiting, flatulence, slight fever, headache and nervousness. The most common route of transmission is through ingestion of mature cysts, which are transmitted mainly by contaminated water and food. The contamination by protozoa *Entamoeba coli* and *Iodamoeba butschlii* is considered non-pathogenic because they are part of the intestinal flora of humans, using intestinal light as a source of food and shelter, without causing any harm to the organism (Neves, 2010; Rey, 2017).

All 26 participants answered the socio-environmental questionnaire and based on the answers, it was possible to draw a profile of the workers through the variables: level of education, hours of work per day in the association, working conditions, the use of safety equipment, income and sanitation. Regarding the level of education, two (7.69%) reported having completed elementary school, 16 (61.53%) said they had an incomplete elementary school, five (19.23%) had completed high school and three (11, 53%) of them report not having completed high school (Figure 3), a result similar to that found in the study by Ribeiro et al. (2014) in RS where low education can be associated with restricted access to information on the correct form of hygiene and prevention these and other parasites.

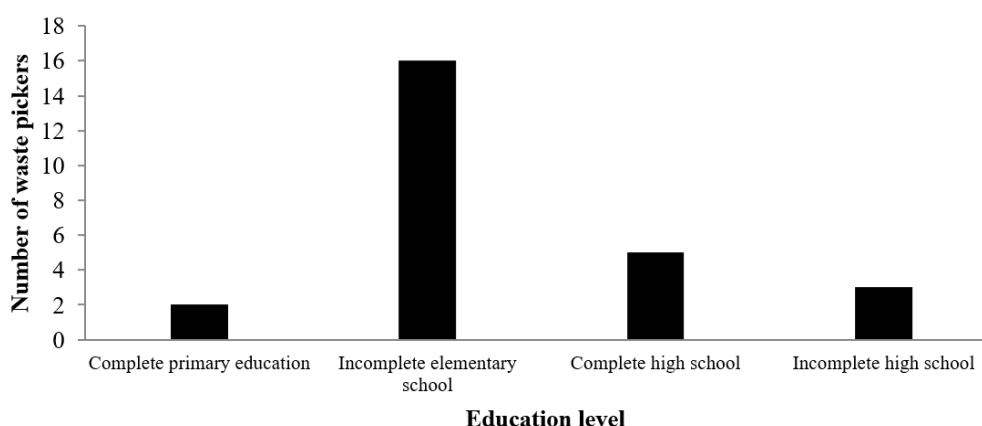


Figure 3. Level of education of waste pickers in the three associations of recyclable material collectors.

Regarding the time of activity, all waste pickers remain in the association for approximately eight hours/day, the same verified by Ribeiro et al. (2014). However, Valente et al. (2016) found hours varying from four hours to eight hours a day. The main income source for 24 waste pickers (92.3%) comes from recycling, as verified by Hernandez et al., (2016), which 92.9% of waste pickers only have the association's activities as a source of income. One person reported to be retired and another offers manicure services. Generally, the income obtained by these workers is not enough to guarantee the basic expenses, since, even with the sale of recyclable materials, the associations have internal expenses, decreasing the final gain for each worker. Among the recyclable material which the waste pickers have the most contact with during collection and separation, the following stand out: plastics, paper, cardboard, aluminum, glass (Table 2).

Table 2. Recyclable materials handled by waste pickers in associations.

Material category	Handled objects	Material category	Handled objects
Paper	Craft, napkin, newspaper/ magazine.	Sharps	Syringes, razor, medicines.
Plastic	Bags and sacks, personal hygiene packaging, disposable packaging.	Glasses	Bottles, lamps, glasses and crockery.
Aluminum	Cans, medicine cards, pots, cutlery	Foods	Rest of food, fruits, processed foods
Cardboard	Boxes and packaging	Fabric/ clothing	Shoes underwear, shirts/ blouses

The categories paper, plastic, cardboard, and aluminum due to their compositions, are less favorable for the survival and development of intestinal parasites. However, food, sharps, and fabrics/clothing, due to their usefulness and nature, consist of potential sources of contamination via water, feces, and secretions. Sharp materials, even though they do not pose a risk of contamination by intestinal parasites, can be contaminating sources of other pathogenic microorganisms such as viruses, fungi, and bacteria. Nowak, Campos, Borba, Ulbricht, and Neves (2010) demonstrate that most accidents with sharps are caused by needles, thus being able to transmit diseases such as HIV/AIDS and hepatitis B and C.

About the use of PPE 50% of the participants reported wearing gloves and safety shoes, 42.30% did not use any type of PPE and 7.69% reported using it sometimes. The reason given for not using it is because of inconvenience and not because it is not available, as members receive a donation of semi-new PPE from companies in the region. Valente et al. (2016) shows in his study that the most used PPE by the interviewees is apron/uniform (48.48%), mask (46.97%), and goggles (33.33%).

In the present study, the reduced use of PPE may have favored the contamination by parasites, considering the reports of the waste pickers (Table 2) during the collection, contact with food, blades, underwear, and disposable diapers. Another factor related to the non-use of PPE refers to occupational accidents, whether during the separation of waste, by sharps, or by the risk during the collection of this waste in homes, performing these activities without any safety equipment. Six (23.08%) waste pickers reported having suffered a work accident that involved cuts with a piece of glass or the truck that collides with the waste picker during the collection of the material. Hoefel et al. (2013) shows that contact with biological materials, present in solid residues, can cause direct or indirect contamination either by diseases of the intestinal tract, viruses, and dermatitis when PPE is not used.

Regarding access to basic sanitation, both at workers' homes and in associations, a waste picker (3%) reported that in the association, drinking water is obtained from the tap and has no treatment; 21 (80.76%) report that the association's water is treated, that is, it is supplied by Supply Company (Copasa); 2 (7.69%) say that the water is filtered. At the waste pickers' residence, 20 (76.92%) said they had treated water; 12 (46.15%) reported using filtered water; three (11.53%), do not have treated water, and two (7.69%) report using well water. Ribeiro et al. (2014) reported in his study that 100% of the interviewed waste pickers who received treated water at home, consumed it. Barçante, Barçante, Narciso, Braz, and Silva (2014) shows in his work that water can transmit cysts of protozoa, eggs, and larvae of helminths, either by ingestion, or indirectly when using in the irrigation of vegetables and vegetables or the use for personal hygiene and recreation.

During the initial visits to the associations and when applying the questionnaire, it was found that the majority of waste pickers use tap water for ingestion, arguing that they have this habit due to the fact that it receives treatment. This demonstrates that, for them, there is a lack of information about the real difference between treated water and filtered water, which suggests that the contamination found in the four waste pickers may have occurred through the ingestion of water. It is important to highlight that even if the water is treated by companies, it is not yet suitable for consumption and it is necessary to filter or boil it before consumption since this is the main vehicle for the transmission of parasitic diseases.

When it comes to the association's sewage 23 (88.46%) claim to have treated sewage, three (11.53%) do not know. In relation to the residence, 24 (92.30%) have treated sewage, and two (7.69%) report having the disposal in a pit. Since most endoparasite contamination is caused by contaminated water and food, there is a risk of using a pit and untreated water (Neves, 2010). Analyzing the health of these scavengers, half of the interviewees reported having fallen ill in the last six months. The volunteers presented different diseases, among them, flu, conjunctivitis, ovarian cyst, urinary tract infection, blood rheumatism, chronic diseases: kidney and heart, and thrombosis.

One of the main symptoms of contamination by parasites found in waste pickers is diarrhea, and six (23.07%) waste pickers reported having this symptom in the last six months, which may indicate possible contamination (Table 3). The main symptoms of parasitosis, when symptomatic, are diarrhea, abdominal pain, malabsorption, and weight loss (Neves, 2010).

Table 3. Symptoms and number of people who reported having them.

Reported symptom	Number of occurrences
None	3
Abdominal pain	10
Blood in the stool	4
Stains on the body	4
Headache	18
Tiredness/fatigue	14
Diarrhea	6
Vomiting	4
Others	7

Domestic animals can sometimes also be considered as means of transmitting parasites and 20 (76.92%) scavengers report having domestic animals such as cats, dogs, chickens, birds, among others. These are capable of transmitting some type of disease, be it infectious or parasitic to man. Silva, Silva, Sposito, and Sperotto (2017) in a study also with waste pickers from the Rio Grande do Sul, showed that 24 (80%) participants claimed to have at least one pet. The fact that most parasites are acquired through contaminated water and food, the existence of a vegetable garden/bed in the waste pickers' house can also contribute to contamination, since the presence of vegetable gardens with food cultivation was common in the household of 15 (57.69%) scavengers. In a study by Ribeiro et al. (2014), it was found that a waste picker maintained the habit of fertilizing the vegetable garden with the feces of animals that existed in the house.

It is known that one of the ways of preventing parasitic diseases is the correct washing of hands after using the toilet and before having meals. In the present study, 25 (96.15%) waste pickers reported washing their hands always in these cases; one (3.84%) reported not having this habit; two (7.69%) only after using the toilet. If the food is not sanitized correctly, it is possible to contain parasite cysts/eggs. Considering that poor food hygiene is a potential way of parasitic contamination, we found that 20 scavengers (76.92%) wash vegetables and vegetables only under running water, three (11.56%) with loofah and detergent, two (7.69%) use bleach and one (3.84%) does not clean before consumption. The food hygiene habits reported by most waste pickers provide evidence that the food consumed by them may be a source of contamination. Silva et al., (2017) carried out work with waste pickers in the city of Cruz Alta, RS, and found that 95% of respondents were in the habit of washing food before consumption.

For the delivery of the reports, the pickers were attended to individually and if positive for parasitosis, contact with the nearest health post was recommended so that a doctor could evaluate and indicate the best treatment. In order to provide them with a better understanding of the ways of transmission of parasitic diseases, we explain to all the pickers present at the delivery meeting that the parasites that were found in the analyzes are parasites transmitted by contaminated water and food and comment on the main behaviors practices, hygiene and water consumption, which could be considered sources of transmission.

To instruct the waste pickers on the importance of the correct use of Personal Protective Equipment (PPE's) during their activities, an informative lecture was given, focused on the collection and management of recyclable waste, given by a student and a teacher in the production engineering course. The lecture was conducted in an exchange of experiences format, where the waste pickers were able to comment on their difficulties and the benefits associated with the use of PPE's. Through the information obtained, we present in a practical way how the correct use of PPE's can reduce the chances of accidents in the workplace as well as possible contamination by vectors and also by pathogenic organisms such as viruses, bacteria, fungi and worms.

Conclusion

Contamination by parasites can hinder the work performance of these scavengers, as they present symptoms such as abdominal pain, headache, and diarrhea, thus preventing the worker from being able to perform their function. Prophylactic measures for parasitic diseases include periodic parasitological examinations, implementation of environmental and health education programs.

It is worth mentioning that the results discussed here have the potential to provide competent organizations with relevant information for the prevention of parasites in waste pickers in the municipality of Conselheiro Lafaiete, through assistance in primary health care and provision of PPE.

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