



Impacts of covid-19 on the management of household and recyclable solid waste. Case study: municipality of Araraquara (SP)

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ABSTRACT

Covid-19 has triggered substantial changes in the lives of the world's population, affecting solid waste management in both developed and developing countries. In Brazil, 37,949,844 people have been confirmed to be infected as of November 18, 2023 and the main form of transmission of the SARS-CoV2 virus was via saliva droplets. The virus can survive on metal or stainless steel surfaces for up to 9 days. The general goal was to analyze the impact of Covid-19 on the collection of household solid waste (HSW) and recyclable solid waste (RSW) in Araraquara (SP) from March 2020 to April 2022. The approach was of exploratory and case study nature, comprised of three stages: I) characterization of the study area; II) monitoring of cases of disease and social isolation; and III) analysis of the interface between the collection of HSW and RSW with Covid-19. The main results have indicated: I) the influence of social isolation and Covid-19 cases on the generation and composition of waste in the municipality; II) a decrease in the mass of HSW and RSW collected by -5.1% and -9% in 2020 compared to 2019; III) a reduction in the average amount of HSW and RSW collected in 2020, 2021 and 2022; and IV) an increase in the disposal of plastic materials, paper and cardboard due to the greater use of single-use packaging and utensils. The main contribution of this study was to point out recommendations to municipal authorities for preventive solid waste management in pandemic cases.

KEYWORDS: Covid-19; Household Solid Waste; Recyclable Solid Waste.

1 INTRODUCTION

The SARS-CoV-2 virus identified in mid-December 2019 in Wuhan, China, was responsible for the emergence of the Covid-19 pandemic. In Brazil, the first case was confirmed on February 26, 2020, in São Paulo (BRASIL, 2020). With rapid transmission, on November 18, 2023, the country has recorded 38,177,375 cases of the virus and 708,491 deaths, with 17.71% confirmed cases and 25.72% deaths registered in the state of São Paulo (SÃO PAULO, 2023).

The symptoms of Covid-19 include fever, chills, sore throat, headache, cough, runny nose, shortness of breath, olfactory disorders or taste disorders (SÃO PAULO, 2023). However, this characteristic has changed rapidly over time with the emergence of new viral variants. At least five variants deemed concerning have been identified, considered to be more transmissible and at greater risk of leading to severe cases: alpha, beta, gamma, delta and omicron (INSTITUTO BUTANTAN, 2021), which may provide the virus with a selective advantage, increasing transmissibility or the ability to evade the host's immune response (SALLAS *et al.*, 2021).

The disease can be transmitted from one infected individual to another through close contact, such as touching contaminated hands, exposure to droplets of saliva or through contaminated objects or surfaces (BRASIL, 2021). With a capacity to remain infectious on inanimate surfaces for a period of 2 hours to 9 days, the survival time of the virus is influenced by factors such as low temperatures, humidity and type of surface (KAMPF *et al.*, 2020).

Considering solid waste as means of transmission of Covid-19, it poses a potential risk to both the general population and professionals working in collection, treatment and final disposal systems. These risks are more significant in regions where basic sanitation is poor or scarce, resulting in limitations in selective collection and the improper disposal of materials in canals and open land (ARAÚJO; SILVA, 2020).

Tackling Covid-19 is linked to pre-existing challenges related to basic sanitation, such as ensuring universal services, waste collection and treatment, as well as the proper disposal of waste (PUGLIESI *et al.*, 2020). In this sense, urban cleaning and solid waste collection are

essential services that ensure the quality of public spaces and reduce the spread of vectors and diseases, favoring the healthiness of the environment (VENTURA *et al.*, 2021).

Among the challenges observed during the pandemic, it is possible to highlight the sudden significant increase in infectious waste and its risk of transmission, and the change in the generation and composition of municipal solid waste (MSW) (HANTOKO *et al.*, 2021), considering that economic and/or health crises can influence changes in habits (OUHSINE *et al.*, 2020).

The increase in COVID-19 cases has raised global concerns regarding the dangers of contamination associated with solid waste management, and the risk of such in increasing the spread of the virus cannot be overlooked. Municipal waste collection systems may not be prepared to deal with the sudden increase in potentially infectious waste (PENTEADO; CASTRO, 2020). Although the proportion of waste which may contain SARS CoV-2 is lower in MSW than in medical waste, its infectious risk cannot be ignored (LIANG *et al.*, 2021)

In the Brazilian context, the main guidelines for solid waste management in the pandemic included maintaining and increasing the frequency of the regular collection service, guidance to the population on the proper way of disposing waste, the implementation of health and safety measures for professionals involved in collection, the adoption of a quarantine period for recyclable materials and the preparation of a Contingency Plan (ABES, 2020).

In this scenario, some researchers such as Tripathi *et al.* (2020), Ventura *et al.* (2020), Abrelpe (2020) and Brasil (2020) clarify that solid waste management is the responsibility of the waste picker and the citizens who generate such materials, and that they must therefore pay attention to the safety of frontline workers. Thus, it was recommended that waste be quarantined for at least 72 hours before final disposal, and that the disposal bag be disinfected with common disinfectants such as 70% ethanol or 0.1% sodium hypochlorite (WHO, 2020).

Although the provision of public basic sanitation services is based on the principle of continuity and regularity, the decision on whether or not to continue selective collection services must take into account the possibility of implementing preventive measures, the conditions of the working environment, the risks to the health and safety of workers and the environmental damage (BRASIL, 2020). Furthermore, the way in which each municipality has faced pandemic events varies from one place to another, as these decisions depend on local restrictions, existing public policies and the availability of resources (CASTRO *et al.*, 2020).

Given the scarcity of information on the handling and management of solid waste during the Covid-19 pandemic, the following are the questions that guided the study: I) Do the number of cases of the disease and social isolation influence the generation and composition of household solid waste and recyclable waste? II) Are the greatest challenges concentrated on the operational side, such as the collection and segregation of materials at the source of generation? and III) Did the collection of household solid waste and recyclable waste occur normally?

The hypotheses assumed for this article were: I) after the beginning of the pandemic and the consequent concentration of people in their homes, there was greater generation of household waste; II) the increase in confirmed cases promotes home isolation and greater generation of household and recyclable waste in homes and establishments with regular collection; III) there was greater collection of paper and cardboard waste due to the change in consumption during the pandemic (online shopping and social isolation).

Thus, the main contribution of this study was to provide guidelines and recommendations to municipal authorities for the preventive management of solid waste in pandemic cases.

2 OBJECTIVES

The objective of this study was to analyze the impact of Covid-19 on the collection of household solid waste and recyclables in the municipality of Araraquara (SP), between March 2020 and April 2022.

3 METHODOLOGY

This research comprises a case study, which is defined as an empirical investigation that investigates a contemporary phenomenon in depth and its real-world context (YIN, R., 2015). The focus of the research is on Household Solid Waste (HSW) and Recyclable Solid Waste (RSW), as shown in Chart 1.

Chart 1- Methodological steps of the research

Stage	Objetivo
1. Characterization of the Study Area	To understand the urban structure of Araraquara (SP) and its management of HSW and RSW.
2. Monitoring of cases of the disease and social isolation	To correlate the data obtained with the status of HSW and RSW collection in the municipality in the subsequent stage.
3. Analysis of the interface between HSW and RSW collection with Covid-19	Analyze the relationship between the pandemic and the collection of this waste and propose future recommendations.

Fonte: Own elaboration (2023), adapted from Morais (2022).

3.1 CHARACTERIZATION OF THE STUDY AREA

The first phase of the research consisted of characterizing the study area, in order to understand the urban structure of the city of Araraquara (SP) and its management of household solid waste and recyclables. To achieve this goal, documents were consulted, such as the Municipal Plan for Integrated Solid Waste Management (PMGIRS), the 2021 annual solid waste diagnosis (referring to 2020), made available through the National Sanitation Information System (SNIS) platform, as well as information available in the city council's websites and the Brazilian Institute of Geography and Statistics (IBGE) Cities virtual platform.

3.2 MONITORING OF COVID-19 CASES AND SOCIAL ISOLATION IN ARARAQUARA (SP)

The second stage of the research involved collecting and updating municipal data on the number of Covid-19 cases and the level of adherence to social isolation. This survey aimed to establish a relationship between social isolation and the variation in the number of Covid-19 cases in the municipality, to later relate them to the amount of solid waste generated.

To record Covid-19 cases in Araraquara (SP), we used the Ministry of Health portal and the Daily Bulletins of the municipality's Coronavirus Contingency Committee. For the analysis, the date of the first case was April 2, 2020. The Intelligent Monitoring System (SIMI-SP), managed by the São Paulo State Government, was used to obtain information on the rate of adherence to social isolation. Updating the social isolation adherence index was only possible until December/2021, since the data available on the website used for this purpose was no longer updated.

3.3 ANALYSIS OF THE INTERFACE BETWEEN SOLID WASTE COLLECTION AND COVID-19

The last phase of the research aimed towards the analysis of the relationship between Covid-19 and the collection of Household Solid Waste (HSW) and Recyclable Waste (RSW), to associate the amount of waste in each category with the number of cases of the disease and adherence to social isolation in the period when the examination has been conducted.

The data required for this analysis were provided by the Autonomous Department of Water and Sewage (Daae) of Araraquara, and covered the years 2019, 2020, 2021 and early 2022 in relation to Household Waste (HSW) and Recyclable Waste (RSW). Details were also provided on the number of cooperative members and absences in the only existing cooperative in the municipality, as well as the amount of each category of recyclable material sold. At the same time, public information available in the National Sanitation Information System (SNIS) for the years 2019 and 2020 was consulted.

These data provided by Daae Araraquara were processed and sent for analysis using Excel® software, and were transformed into percentages when necessary. The results of this stage include: I) the percentage difference in HSW and RSW collection in the years 2020/2019; II) overview of the collection of HSW, RSW, and sale of recyclable materials (plastic, paper and cardboard) from January 2020 to April 2022; and III) comparison of the per capita mass collected from HSW and RSW in the period which was analysed, with the average recorded in the PMGIRS.

Part of the data provided by Daae for this stage was used in the elaboration of the article entitled "Analysis of the impacts of Covid-19 on the collection of household, recyclable and health service solid waste in the municipality of Araraquara (SP), Brazil", carried out by Ventura *et al.* (2021).

4 RESULTS

4.1 CHARACTERIZATION OF THE STUDY AREA

The municipality of Araraquara, located in the central region of the State of São Paulo, has a total area of 1,003,625 km², of which about 80 km² correspond to the urban area. The estimated population in 2020 was 238,339 inhabitants, HDI of 0.815 (2010) and GDP per capita of R\$ 40,253.93 (2018) (IBGE, 2020). Its solid waste management is the responsibility of the Daae, which is responsible for the management of the collectors' cooperative, selective and regular collection, transportation and operation of the landfill, incinerator, debris pockets and

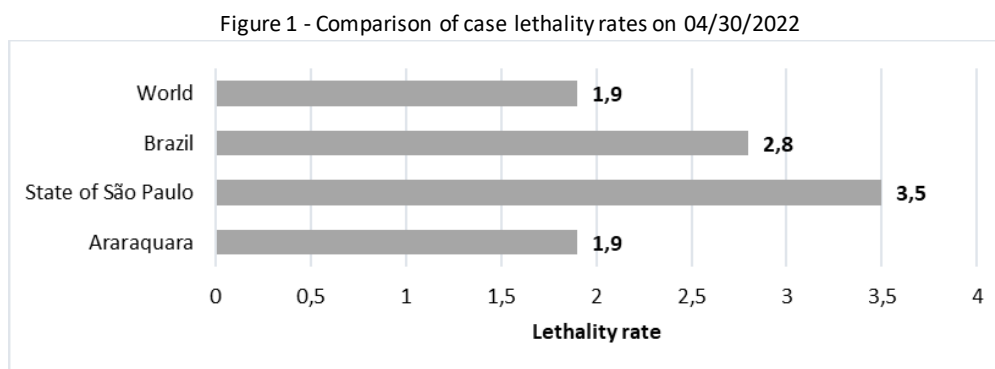
urban cleaning service (ARARAQUARA, 2013). Araraquara has 100% coverage of regular and selective collection for its urban area (BRASIL, 2020), with the final destination being the landfill of the Waste Management Center (CGR), located in Guatapar (SP), about 50 km away from the municipality (ARARAQUARA, 2013).

Because of the growing number of cases during the pandemic in Araraquara (SP) in 2021, the city government established two criteria for lockdown in the municipality: if 20% of Covid-19 tests were positive for three consecutive days or five interspersed; or if 30% of people with flu symptoms were diagnosed with the virus. Despite the positive effects observed after the first lockdown, when there was great engagement among the population; about four months later, the city once more observed a growth in the number of cases, and a new lockdown was decreed on June 17, 2021 (CNN, 2021).

4.2 MONITORING OF COVID-19 CASES AND SOCIAL ISOLATION IN ARARAQUARA (SP)

4.2.1 Evolution of Covid-19 cases

In continuity with the aforementioned research, coping with the disease in the municipality of Araraquara (SP) was compared to the global, national (Brazil), and state (State of So Paulo) contexts. Figure 1 illustrates the case/lethality rate (%), obtained by confirmed cases on the last reference date (04/30/2022).



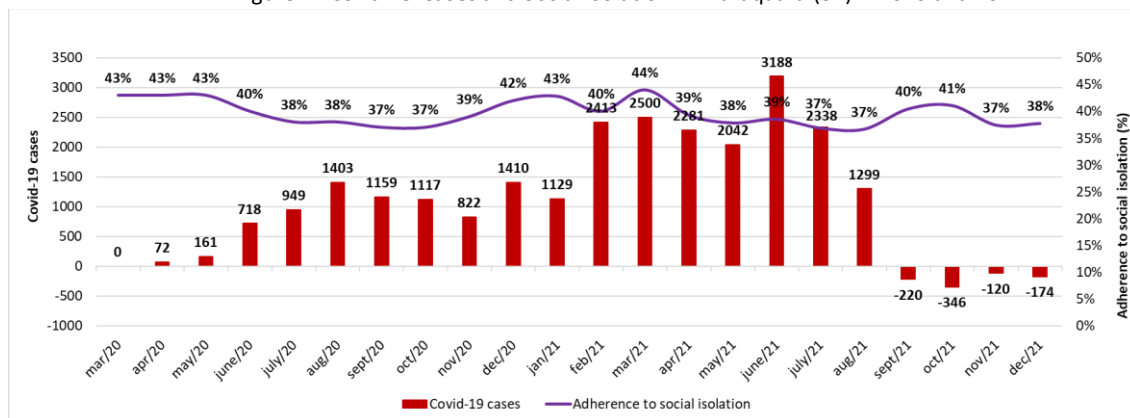
Source: Own elaboration (2023), adapted from Morais (2022), based on So Paulo (2022); CONASS (2022) and Araraquara (2022).

Araraquara (SP) had lower case/lethality rates (1.9%) when compared to the national scenario (2.8%) and the State of So Paulo (3.5%), matching the world rate (1.9%), as shown in Figure 1. These data demonstrate that the actions established in the municipality, such as the implementation of two *lockdowns*, brought positive effects, especially the first, when the lack of knowledge about contamination and the adequacy of MSW management were under discussion in the country, and few preventive alternatives were clarified in the state and national context.

4.2.2 The population's adherence to social isolation at the beginning of the Covid-19 pandemic

Figure 2 illustrates the variation in the number of cases and the rate of adherence to social isolation in 2020 and 2021. In 2020, only the months from March onwards were considered, considering the beginning of the number of Covid-19 cases in the municipality.

Figure 2 - Covid-19 Cases and Social Isolation in Araraquara (SP) in 2020 and 2021.



Source: Own elaboration (2023), adapted from Moraes (2022), based on São Paulo (2021) and Brazil (2022).

In 2020, it is observed that the highest rate of adherence to social isolation (Figure 2) occurred at the beginning of the pandemic, in the months of March, April and May (43%), declining from June onwards (40%). The lowest rates were recorded in September and October, at 37%. Regarding the number of cases, these were higher in August (1403) and December (1410).

For the year 2021, it is possible to observe a greater variation in the rate of adherence to social isolation. In January, the rate was 43%, declining to 40% in February. In March, the rate reached its highest value (44%), before declining in subsequent months, with the lowest value recorded in July and November (37%). As for Covid-19 cases, these maintained numbers higher than 2000 from February to July, reaching the peak in June, with 3188 cases. After September, there were changes in the system for counting cases, with negative numbers being counted.

Therefore, it was discovered that the decrease in the social isolation index may have influenced the increase in Covid-19 cases in the municipality in 2020 and 2021, when there was a significant jump from 161 cases in May/20 to 718 cases in Jun/20 and 1129 cases in Jan/21 to 2413 in Feb/21, both increases occurred after the decline in social isolation. In addition, the increase in cases of the disease did not influence the increase in social isolation of the population, as verified in Jun/21, the month in which there was the highest number of cases in the analysed period and only 39% of the population's adherence to social isolation.

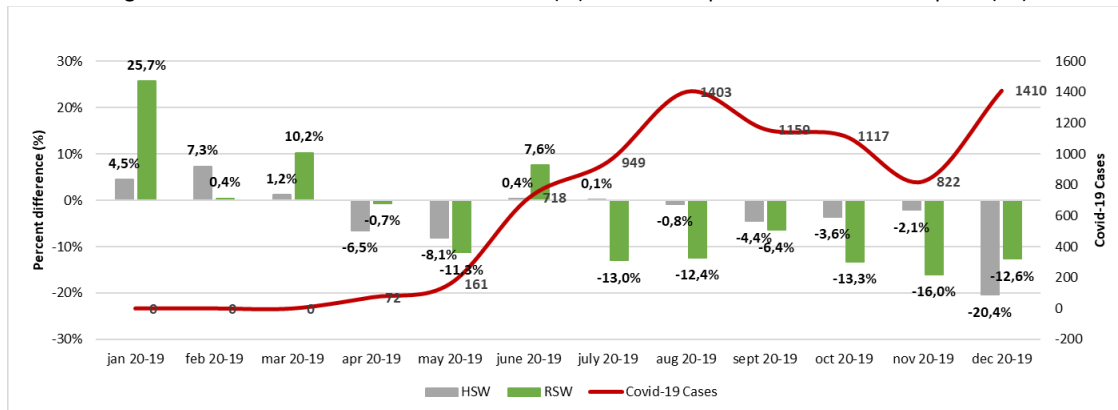
4.3 INTERFACE OF SOLID WASTE COLLECTION WITH COVID-19

4.3.1 Comparison of HSW and RSW collection and sale of recyclable materials in Araraquara (SP) in 2020 compared to 2019

4.3.1.1 Collection of HSW and RSW (2020/2019) according to data provided by Daae

Due to the lack of understanding about the transmission and effects of the virus in the early months of the pandemic, many cities temporarily modified solid waste management (CASTRO *et al.*, 2020; LIANG *et al.*, 2021; ZAMBRANO-MONSERRATE *et al.*, 2020; NAUGHTON, 2020;). In this sense, this analysis was conducted to examine the variations in the amount of HSW and RSW collected, as well as the sales of recyclable materials (plastic, paper, and cardboard) in the years 2019 and 2020 (pre- and post-pandemic period). These data were organized with the cases of Covid-19 registered in the municipality (**Figure 3**), in the search for possible connections.

Figure 3 - Mass collected from HSW and RSW (%) in 2020 compared to 2019 in Araraquara (SP)



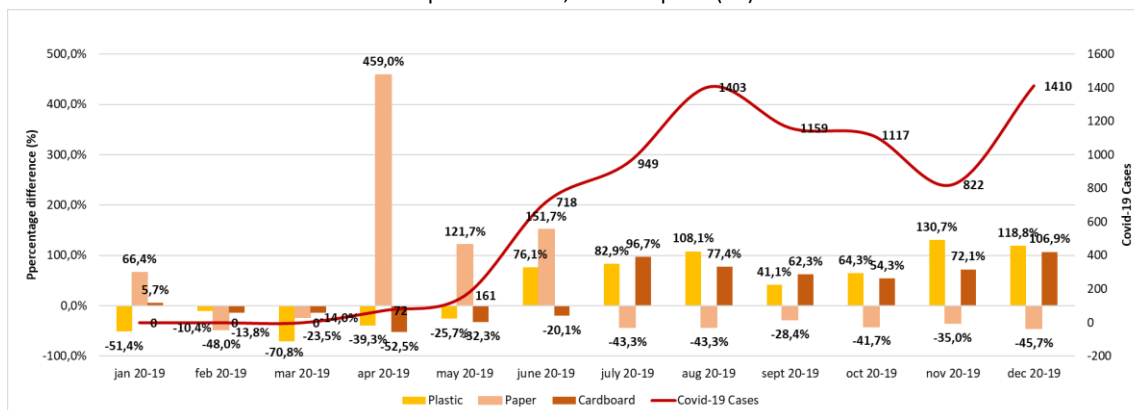
Source: Own elaboration (2023), adapted from Moraes (2022) and Ventura *et al.* (2021), based on Daae (2020).

From April (19/20), there was a significant decrease in **HSW** collection (-6.5%), coinciding with the onset of Covid-19 cases in the municipality (Figure 3). The decrease persisted in the subsequent months, reaching its highest value in December (-20.4%), the month that also had the highest number of cases (1410). When considering the averages from April to December (20/19), there was a deficit of -5.1%. This reduction can be attributed to the economic downturn that occurred during the period, which may have influenced the reduction of waste generation by the inhabitants, especially in months with a higher number of cases of the disease.

Regarding the **RSW** (Figure 3), from the month in which the first Covid-19 case was registered in the municipality (Apr/20), there was a reduction in the amount of mass collected from them in all months, except June. This trend suggests that the increase in cases of the disease had an impact on the use of inputs with recycling potential by the population, resulting in a deficit of -9% from April to December (19/20).

Considering that there was no reduction in selective collection activities in Araraquara (SP), with only the adoption of safety measures, **Figure 4** shows the difference in the average percentage (2020/2019) of the average sales of plastic, paper, and cardboard materials.

Figure 4 - Percentage difference in the sale of plastic waste, paper and cardboard in January to December 2020 compared to 2019, in Araraquara (SP).



Source: Own elaboration (2023), adapted from Moraes (2022) and Ventura et al. (2021) based on Daae (2020).

The sale of **plastic** (Figure 4) has decreased in the first five months, before increasing by 76.1% from June (19/20). This increase coincides with the evolution of Covid-19 cases, when the municipality jumped from 161 cases in May to 718 cases in June. The use of this type of material showed an average increase of 61.9% from April to December, with a peak in November (131%). This increase was likely caused by the sudden demand for products to protect workers and the general public, such as personal protective equipment (PPE) and disposable supplies, as well as the increase in online purchases of goods and groceries (SHARMA *et al.*, 2020; KLEMES *et al.*, 2020; CHOWDHURY *et al.*, 2022)

The sale of **paper** (Figure 4) reached its peak in April (19/20), concomitantly with the onset of cases of the disease in the municipality, registering an extraordinary increase of 450%. This significant increase can be attributed to an atypical situation related to cleaning in homes, schools and offices. As people began having more idling time, it is possible that they discarded materials such as unused books and other printed matter. In the following months, there was a decrease, with negative values from August (-43.3%), and reaching its lowest value in December (-45.7%), totalling an average increase of 60% between April and December.

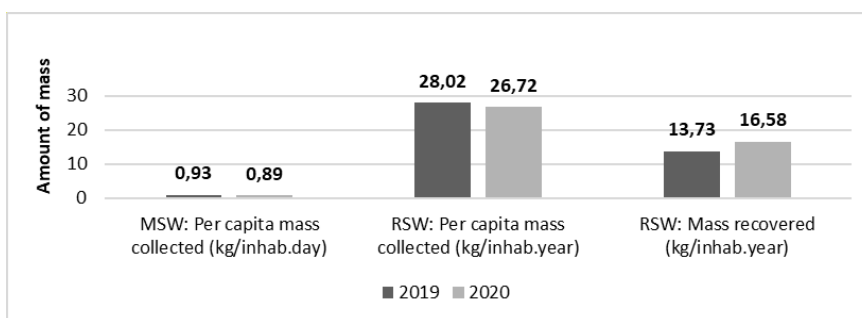
The sale of **cardboard** (Figure 4) showed a slight increase in January (5.7%), followed by a decrease in the following five months, with the lowest percentage of mass collected in May (-52.5%). From July onwards, there was a significant expansion in the amount collected (96.7%), reaching a peak in December (106.9%), pointing to an average increase of 40.5% between April and December.

There was a significant increase in demand for online food and consumer product delivery services, especially during the *lockdown* period, which likely contributed to the increase in packaging disposal in the early months of the pandemic (HANTOKO *et al.*, 2021). These packages are usually bulky, designed to ensure protection during transport, and result in a significant amount of plastic, paper, and cardboard relative to the volume of the products contained within.

4.3.1.2 Collection of MSW and RSW According to SNIS (2020/2019)

In 2020, the per capita collection of MSW corresponded to a total of 0.89 kg/inhab.day compared to 0.93 kg/inhab.day recorded in the previous year (Figure 5) (BRASIL, 2020b; BRAZIL, 2021). There was, therefore, a decline of approximately 4.7%. Regarding RSW, 26.72 kg/inhab.year were recorded in 2020 and 28.02 kg/inhab.year in 2019 (-4.6%).

Figure 5 - Mass of MSW and RSW collected in Araraquara (SP) in kg/inhabitantday and kg/inhab.year, in the years 2019 and 2020.



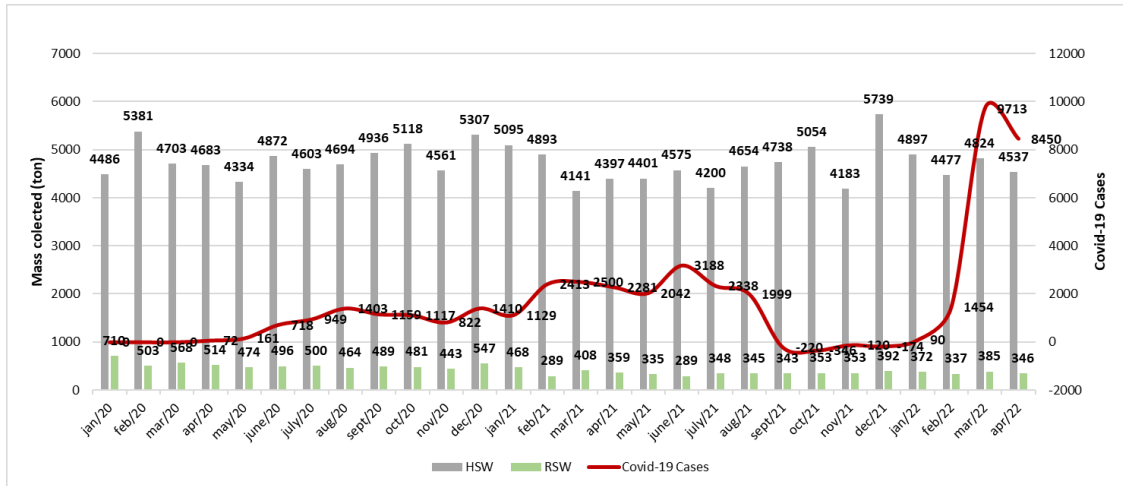
Source: Own elaboration (2023), based on Morais (2022), Brazil (2020b) and Brazil (2021).

Although the amount of per capita mass collected from RSW was lower in 2020, the amount recovered was 2.85 kg/inhab.year higher than that recorded in 2019 (Figure 5). This increase may be related to the increased awareness of the population about the importance of proper separation of materials, especially during the pandemic period, which requires further investigation to confirm this assumption. In addition, waste pickers may have had a greater commitment to the separation of materials, due to the need of increasing their income during an economic crisis.

4.3.2 Analysis of HSW and RSW collection and sale of recyclable materials from January 2020 to April 2022 in Araraquara (SP)

Figure 6 shows the numbers related to the collection of HSW and RSW and cases of the disease in the years 2020, 2021 and the first four months of 2022.

Figure 6 - Collection of HSW, RSW, and Covid-19 cases from January 2020 to April 2022 in Araraquara (SP).



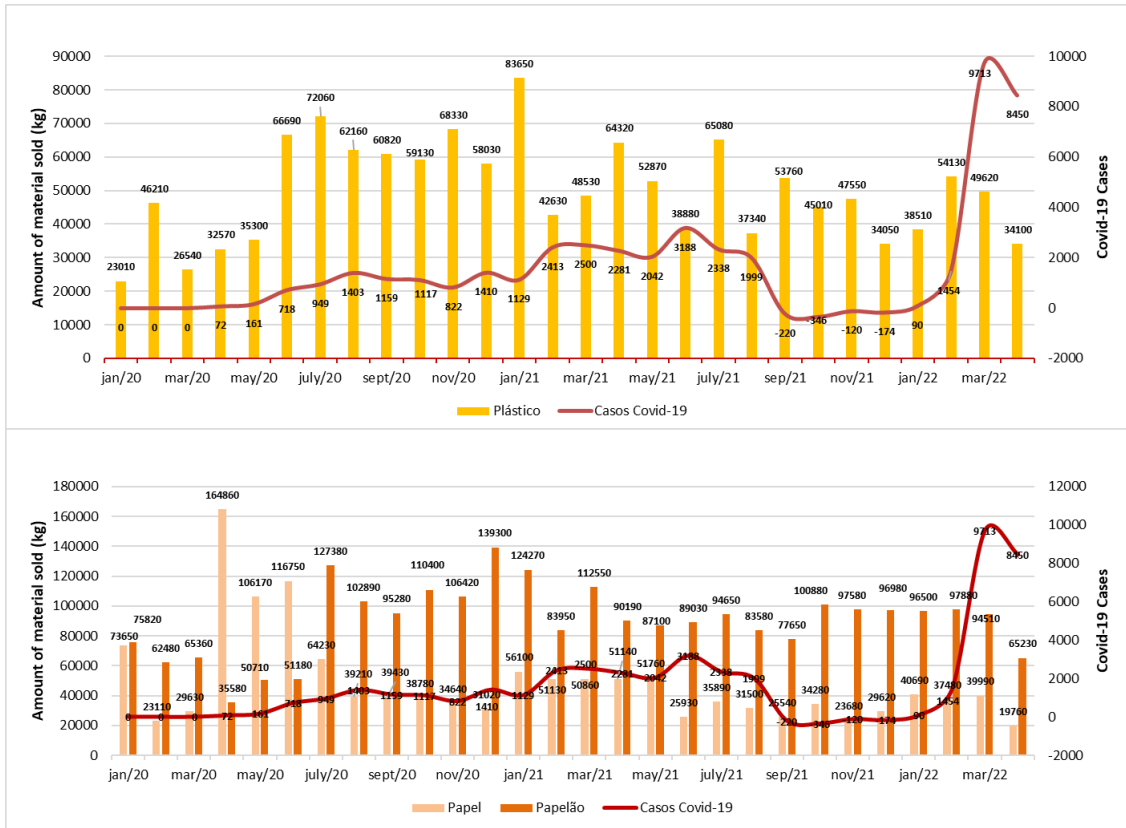
Source: Own elaboration (2023), adapted from Morais (2022), based on Daae (2022)

The highest amount of **HSW** collected (5739 tons) was recorded in Dec/2021, a period in which no new cases of the disease were recorded. The lowest amount (4141 tons) was recorded in Mar/2021, when the population totalled 2413 Covid-19 cases. At the beginning of 2022, when cases of the disease increased significantly again, reaching a peak in Mar/2022 (9,713 cases), there was also a reduction in the amount collected, indicating a possible relationship.

Regarding the collection of **RSW** (Figure 6), it is possible to observe that the highest amount of recyclable materials collected during the entire period was recorded in Jan/2020, with about 710 tons, when the pandemic had not yet affected the municipality. It is also inferred that the increase in cases of the disease at the beginning of 2021 was reflected in the consumption of recyclable materials, which went from 468 tons in Jan/2021 to 289 tons in Feb/2021, being the lowest amount recorded in the entire period analysed. The decrease in RSW collection lasted until the end of the analysed period. In the years 2021 and 2022, only in Jan/2021 and Mar/2021 the amount collected has exceeded 400 tons.

Figure 7 shows the values related to the sale of plastics, paper, and cardboard in the period between January 2020 and April 2022 in Araraquara (SP).

Figure 7 - Sales of plastic, paper, and cardboard from January 2020 to April 2022 in Araraquara (SP)

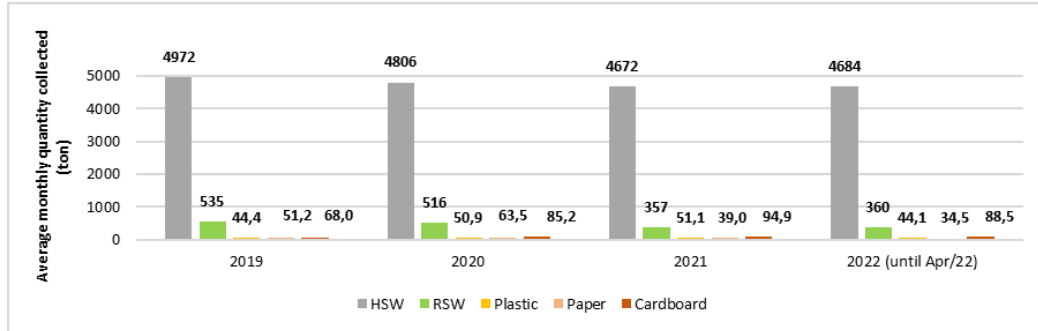


Source: Own elaboration (2023), adapted from Morais (2022), based on Daae (2022).

There was an increase in the sale of **plastics** (Figure 7) from Jun/2020 onwards, extending until Jan/2021, the month in which the largest amount of the material sold (83650 kg) was sold. Subsequently, a decrease is observed over the period analysed. The increase in this type of material at the beginning of the pandemic is justified by the increase in care of the population through single-use/disposable materials. However, as restrictions have been eased, the population's wariness of preventive measures has eased. Regarding the sale of **paper** and **cardboard** (Figure 7), the first reached its highest value in Apr/2020, with 164860kg, and the second, in Dec/2020, with 139300kg.

The monthly averages collected in 2019, 2020, 2021 and 2022 (until Apr/2022) for HSW, RSW, plastic, paper and cardboard were summarized in **Figure 8**.

Figure 8 – Monthly average, in tons, of HSW, RSW and plastic, paper and cardboard materials sold from 2019 to 2022

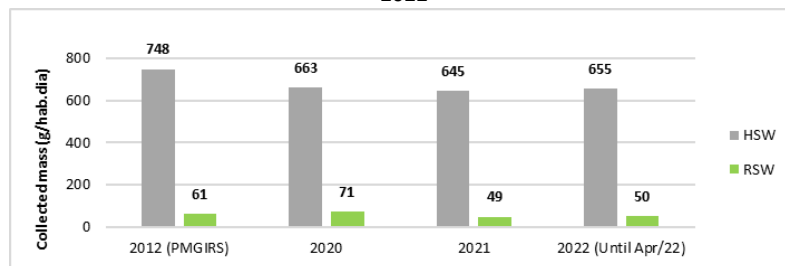


Source: Own elaboration (2023), adapted from Morais (2022), based on Daae (2022).

There was a reduction in the average monthly amount of both HSW and RSW collected (Figure 9), when compared to the pre-pandemic scenario. However, the sale of recyclable materials has increased, especially for plastic and cardboard materials.

Figure 9 illustrates the per capita mass collected of MSW and SRW in comparison to the values presented in the PMGIRS (2012).

Figure 9 - Per capita mass collected, in grams per day, of HSW and RSW in the years 2012 (PMGIRS), 2020, 2021 and 2022



Source: Own elaboration (2023), adapted from Morais (2022), based on Daae (2022) and Araraquara (2013).

It is calculated that for a population of 238,339 inhabitants (IBGE, 2020), the average HSW and RSW per capita generated in the years 2020, 2021 and 2022 (until April/2022) was, respectively, 663, 645 and 655 g/inhab.day and 71, 49 and 50 g/inhab.day (Figure 10). According to the municipality's PMGIRS, the last average adopted for the collection of HSW was 748 g/inhab.day and 61 g/inhab.day for RSW (ARARAQUARA, 2013). Therefore, there was a reduction in the collected mass of about -11.36%, -13.77%, and -12.43% for HSW and +16.39%, -19.67% and -18.03% for RSW in the years 2020, 2021, and 2022, respectively, compared to what was indicated in the plan.

4.3.3 Recommendations for the management of HSW and RSW in the face of pandemic events

The research has evidenced the usefulness of a continuous database on waste generation and management. This information is useful for predicting waste generation and preparing effective and resilient management for any future outbreak (ROY *et al.*, 2021). The complexity of acquiring waste-related information highlights that the obstacles are not restricted to operational issues alone, and it is necessary to implement effective monitoring systems to

track the generation, collection, and final disposal of waste into waste at the local and regional levels. It is also recommended to implement regulations that require companies and public institutions to disclose information on waste management, including annual reports on the amount and destination of waste.

The study warns about the increased use of plastics and other single-use materials during pandemics, highlighting the need to review strategies to opt for solutions such as sanitizing substances. The reuse of materials can be feasible through the implementation of sanitization and disinfection measures, avoiding the disposal of materials that increase the volume of waste and can contribute to the spreading of the virus. Investments in waste management, including the provision of environmentally friendly products and regulation on improper disposal can help reduce the impacts generated by mismanagement during the Covid-19 pandemic (SARKAR *et al.*, 2023).

In future pandemic events, it is also recommended that municipal governments disseminate more information to the population regarding the proper separation of materials at source in pandemic events, as well as the availability of special bins in public places for the disposal of PPE.

5 CONCLUSION

The study achieved its main objective, which was to highlight the global impact of Covid-19 on solid waste management, and such has led to adaptations in the population's lifestyle and changed the composition and generation of household solid waste and recyclables, as seen in the municipality of Araraquara (SP). The increase in cases of the disease in the municipality did not cause an increase in household solid waste generated in homes, but promoted the reduction of waste instead, contrary to hypotheses I and II assumed for the study.

A decrease in the collected mass of household solid waste and recyclables was observed when comparing the year 2020 to 2019 (pre-pandemic) and throughout the period evaluated, especially in months with a higher number of Covid-19 cases. These results corroborate the data provided by the National Sanitation Information System (SNIS) of the Ministry of Cities.

In addition, the annual average of the amount collected, in tons, of HSW and RSW in the years 2020 to April 2022 supplied by Daae was lower than the average recorded in 2019. When comparing the per capita values, in grams, of the same period to the PMGIRS of the municipality, only the year 2020 presented a value higher than that indicated in 2012.

Regarding the sale of recyclable materials, there was an increase mainly in the sale of plastic and cardboard materials, because of greater adherence to purchases made through the *online market* (*websites* and applications), which has led to greater disposal of packaging, confirming hypothesis III., as well as greater efforts in separating waste by pickers due to the need of supplementing income.

The Covid-19 pandemic, albeit having drastically and overwhelmingly, in 2020, interfered precisely with the segregation of MSW and SRW directly at the source of origin and, consequently, with the collection of these materials on a global scale. It was an immediate

challenge for municipalities that had no national or state guidelines, due to the discussion which still was in progress at the time. In this way, public managers, who have redesigned solid waste management actions and included preventive measures for possible viral contamination events related to solid waste, took advantage of this event to establish public policies focused on worker health and prevention of operational practices with risk management for contamination in pandemic cases.

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