

Reduction of work accidents through the implementation of containers for solid waste collection

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Abstract

The activity of waste collection is fundamental for preserving human health and the environment. As the world population increases, so does the waste production, consequently leading to a higher number of professionals involved in the collection activity. The objective of this study was to identify the main causes of accidents in urban waste collection and to verify if the implementation of containers would reduce the number of accidents in the sector. The causes were identified by analyzing accidents in two waste-collection companies for 4 years. Company A had 3,859 employees with 756 registered accident cases, while company B had 2020 workers with 189 cases. In total, it was analyzed 945 accident cases from urban waste collection. One municipality from company A which implemented the highest number of containers was studied thoroughly to verify if the implementation of containers reduces the number of accidents. The analysis shows that the household collection had the highest accident rate, with 65.61%. Sharp materials and falls were the leading causes of accidents, representing 53% in the company A and 62% in the company B. After containers implementation, the number of accidents caused by sharp materials and falls decreased from 37 without the container in 2014, to 18 with the container in 2015, and 11 with the container in 2016. It was concluded that the implementation of containers improves occupational safety and health during the urban cleaning process. Further studies should be conducted in order to improve the working conditions in the urban cleaning sector.

1. INTRODUCTION

According to the Brazilian Association of Public Cleaning and Special Waste Companies (Abrelpe, 2017), Brazil annually generates 78.4 million tons of urban solid waste. In 2017, the Brazilian municipalities invested an average of R\$ 10.37 per inhabitant per month in the urban cleaning service. Despite the financial crisis in Brazil, the resources movement in the sector corresponded to R\$ 28.5 billion. The urban cleaning service consisted of 337 thousand formal jobs, where 59.1% of the produced waste was collected and destined to landfills, while additional waste was discarded inadequately. This shows that the urban cleaning sector still needs to grow in order to attend present necessities and that in the near future it will be necessary to apply more resources and hire new professionals.

In Brazil, there is a great difficulty to implement a unified urban cleaning system, considering that the country has a large extension and has developed unevenly, with

most of the population concentrated in the coastal region, due to different topographies and infrastructures. It is possible to note cultural and income differences across different regions of the country. These variations had a direct influence on the methodology used for waste collection since the sites generate different types and amount of waste (Eigenheer 2009).

When solid waste is discharged inadequately, it can pose problems for the society, leading to the proliferation of rats, cockroaches, flies, among other disease vectors. It can also cause diseases among workers who have direct or indirect contact with wastes, such as, headaches and vomiting, by the odour, or contamination through the contact of the infected material. The employer is also affected when the solid waste is discharged in a defective manner, as improper storage raises the time required to collect waste (Diniz ET AL., 2018; National Secretary of Environmental Sanitation, 2008).

Nevertheless, occupational safety and health problems are not exclusive to Brazil. Worldwide, there have been several studies on work accidents and safety and health risk management. In Paraguay, a study conducted by Flores, Carvalho e Radon (2018) concluded that each year about 37.5% of collecting workers suffer work accident; which is in accordance with the data published by the Canadian Union of Public Employees (CUPE, 2010) showing a percentage of 35%; and in accordance with the data from Ethiopia showing a percentage of 34.3% of collecting workers suffering accidents every year (Eskezia ET AL., 2016). The Bureau of Labor Statistics (BLS) from USA (United States of America, 2017) show similar results, stating that the activities of waste collection and maintenance are one the top five services which were responsible for most accidents, with the risk for waste collectors being 10 times higher compared with the mean value from all other sectors in the USA.

In addition to all the mentioned problems, the occurrence of work-related accidents is common in the urban cleaning service. According to a study carried-out by Velloso, Santos, and Anjos (1997), 80% of the waste collectors suffered work accidents during the collection activity. Studies show that waste collection is one of the most dangerous activities with a high risk of exposure to sharp materials and bacteria's (Tibbetts, 2013). A study conducted in South Korea (Jeong, Lee, and Lee 2016) show that falls (including falls as a result of slips and falls from height) represent 42.4% of all analyzed accidents, while traffic accidents and represent 13.6%, musculoskeletal disorders result in 11.1%, while other types of accidents are accounted for 32.9%. Another study, carried-out by Diniz et al. (2019) pointed out that "Affected by object/tool", "Traffic", "Falls" and "Sharp materials" were the main causes of accidents among waste collectors, where "Sharp materials" represented more than 50% of major causes. One of the proposals brought by Diniz et al. (2019) was to carry out a study to verify if the implementation of communal waste containers built according to the standard (ABNT, 1993), would reduce the number of accidents resulting from urban cleaning.

Therefore, the objective of this study was to analyze the leading causes of occupational accidents in the urban cleaning service and to verify if the implementation of containers would reduce the number of accidents.

2. MATERIALS AND METHODS

The study was subdivided into two phases. The main causes of accidents were identified in the first phase, while in the second phase was verified and analyzed the effect of the implementation of containers on major causes of accidents, as illustrated in Figure 1.

2.1. Identification of the causes of accidents

In order to identify the main causes of accidents, this study considered accident data from two large waste collecting companies (company A and B) operating in different Brazilian cities. The companies were subject to the same legislation and thus were obliged to offer the same conditions, having as main variable the number of workers. In total, this study considered data from two companies during 4 years, which conducted

the public waste collection in 14 municipalities, with a total number of 945 accident cases.

For company A, accidents between 2014 and 2016 were considered. During this period, the number of workers increased from 3380 to 3859. The company was responsible for waste collection in 13 municipalities (9 municipalities in the state of Pernambuco, 2 municipalities in the state of Rio de Janeiro, 1 municipality in the state of Bahia and 1 municipality in the state of Mato Grosso). The total number of accidents which occurred in company A during that period was 756.

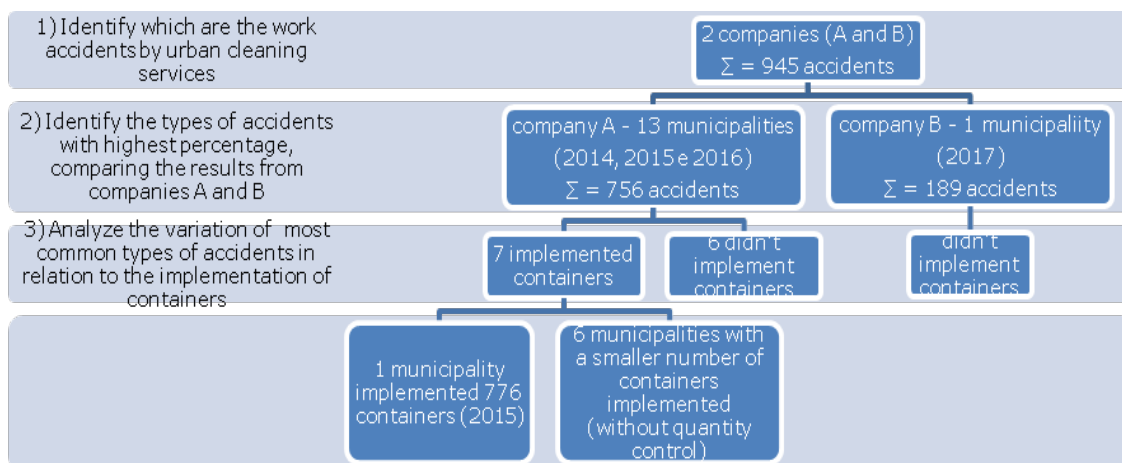


Figure 1. Fluxogram the phases of analysis in the study.

For company B, were considered accidents that occurred in one year (2017), during which the number of workers corresponded to 2020. The company was operating in one municipality (the metropolitan region of Recife, State of Pernambuco). The total number of accidents which occurred in company B during that period was 189.

This phase of study analysis was subdivided into two parts. First, all accident cases were analysed based on the type of urban cleaning service in which the accident occurred. Subsequently, accidents were grouped by type, and their relative percentage was calculated. The percentages of accidents were afterwards compared between two analyzed companies A and B.

2.2. Container as a risk management tool

Company A conducted the public waste collection in 13 municipalities, from which 7 municipalities' implemented containers, while 6 did not. The company decided to implement containers as a strategy to improve safety for workers and increase production. The containers were implemented in 7 from 9 municipalities located in Pernambuco. Company B did not implement any containers during the analyzed period.

From the 7 municipalities which implemented containers, six implemented a smaller number of containers, without any quantity control. Therefore, the seventh, with the highest number of implemented containers, was selected to study thoroughly if the implementation of containers would reduce the number of major accidents (sharp materials and falls). The accidents were analyzed during three years, in 2014 when there were no containers, and comparing it with 2015 and 2016 when 776 containers of 1,000 litres were implemented.

The municipality was located in the metropolitan region of Recife, with an area of 2,768 km², with a population of 4,046,845 inhabitants (IBGE - Instituto Brazilian Geography and Statistics 2013). The municipality is coastal with a waterfront of 14 km, and the predominant activities in the sector are services, commerce and industry. Therefore, due to the number of tourists that come to visit the municipality, the generation of waste tends to be higher with the generation of 1,065 kg of waste per inhabitant per day

(Recife, 2011). All containers were the same model “Contemar Ambiental”, which was illustrated in Figure 2.



Figure 2. Container (Contemar Ambiental, 2018)

The containers were localized in the main avenues of the municipality, on state roads and avenues near the beaches. The company localized one container every 50 meters on the beach avenue. In the state roads, the distance between containers was not standardized. Additional containers were localized throughout the city on the main points of waste generation, such as fairs and public squares.

It is important to mention that it is not common to establish containers in Brazilian municipalities, thus having a greater difficulty during the implementation period, since it is necessary first to carry-out environmental education actions with the population for the proper use of containers, as well as to additionally train collection workers. In 2015 all workers received training on how to use containers, while in 2016 training were given only to newly arrived workers.

3. RESULTS AND DISCUSSION

3.1. Causes of accidents

Figure 3 shows the number of accidents by type of service occurred within the analyzed years in companies A and B, and the Pareto principle represented with an orange line. This illustration aims to show the groups of urban cleaning services with most accident cases. The *x-axis* represents the type of service, the *left y-axis* the number of accidents that occurred in the service, while the *right y-axis* shows the percentage of the cumulative of services of the total number of accidents represent the sum of the accidents from the left to the right columns.

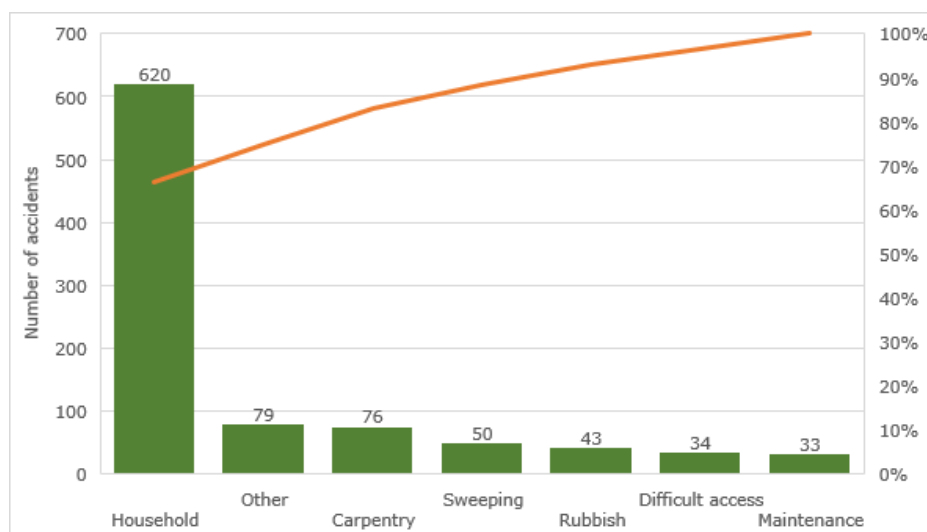


Figure 3. Work accidents in urban cleaning services from companies A and B during the years from 2014 to 2017

As shown in Figure 3, there were a total of 945 cases of accidents in analyzed companies A and B. The household collection was responsible for 620 accidents, representing 65.61% of the total number of accidents. Therefore it is clear that it is a priority to solve accidents which are occurring during household collection. The second column named "others" accounted for 79 accidents (8,36%), representing services as tree pruning, selective collecting, maintenance, preservation of public squares, landfill, correlates, special operations and administrative services.

Figure 4 shows which are the leading causes of those 620 accidents occurred during household collection. From those 620 cases, 540 occurred in company A during a period from 2014 to 2016, representing 100% of cases within the company, shown in Figure 4 in dark green colour. While 80 accidents occurred in company B in 2017, representing 100% of cases within the company, shown in figure 4 in light green.

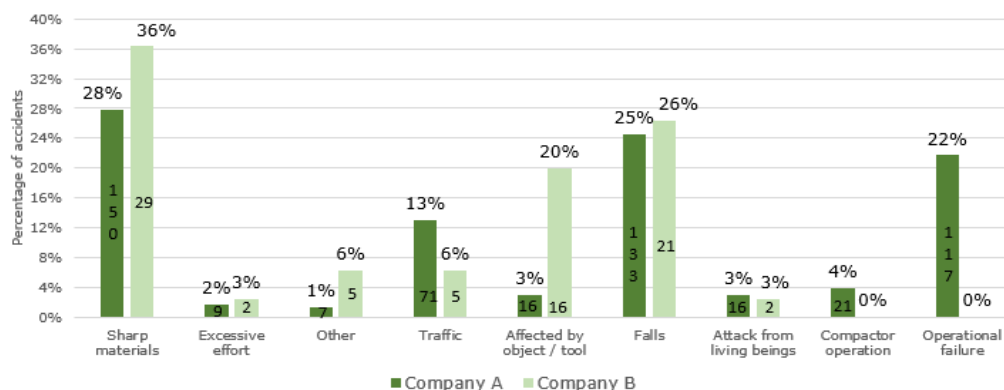


Figure 4. Work-related accidents in the household collection in companies A and B during the observed period

Through analyzing gathered results, it was concluded that by comparing the number of workers and the number of accidents, there was 1 accident per 5 workers.

According to Figure 4, accidents with sharp materials represented in company A were 28% (150 cases) and in the company B were 36% (29 cases) of all causes of accidents of each company. Falls were the second major cause of accidents with 25% (133 cases) in company A and 26% (21 cases) in company B. Falls included falls from the truck, falls from standing height and other types of falls. This shows that sharp materials and falls are the two major risks for workers participating in the urban cleaning operation. Company A had various cases classified as "operational failure", which could have included sharp materials, falls, but also any other cause of accident. Therefore, it was decided to leave it as a separate group, rather than speculate with it.

The conclusions made by Diniz et al. (2019), analyzing leading causes of accidents in the process of urban waste collection in Brazil, found that in a total of 473 accident cases, 45.03% were caused by sharp materials and 25.37% by falls. Combined, these two causes accounted for 70.40% of all recorded accidents in the urban solid waste collection service. This is in accordance with the results from the present study, where sharp materials and falls were responsible in company A for 53% and company B for 62%, showing that there is a need to focus on reducing those two causes of accidents.

3.2. Implementation of the container

The effect of the containers' implementation was studied only in one municipality during the period from 2014 to 2016, as already described in the methodology section. The total number of accidents was 112, where sharp materials and falls caused 66. As those two were the major causes, further analyses were focused on them.

Figure 5 shows the number of accidents caused by sharp materials and falls during each year, where 2014 was without the implementation of containers, while in 2015 and 2016, there were 776 containers implemented.

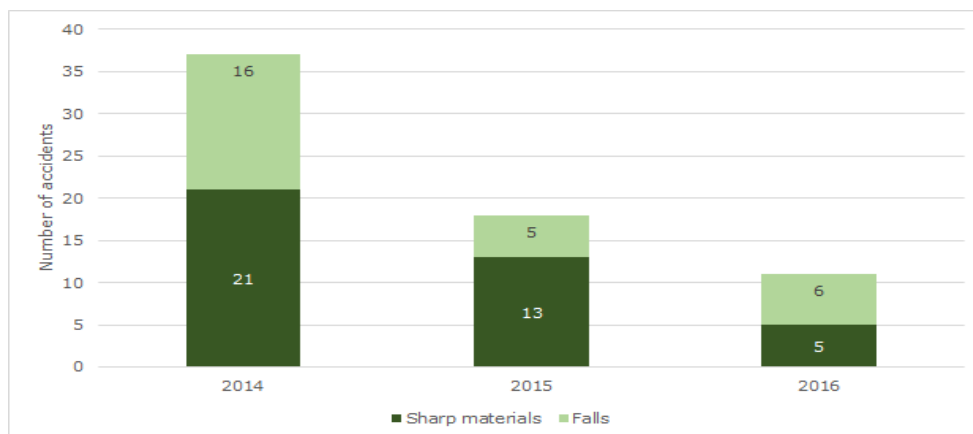


Figure 5. Number of accidents with sharp materials and falls in the company A

According to [Figure 5](#), sharp materials and falls in 2014 caused 37 accidents, while after implementing containers in 2015, the number decreased to 18 accidents, which represents a decrease of 51.35%. Comparing the number of accidents between 2014 and 2016 was a reduction of 70.27%. This can be explained with the implementation of containers, as the worker was less exposed to waste, having, therefore, lower risk to suffer accidents caused by sharp materials and or falls during the operation.

[Figure 6](#) shows a comparison of the average number of accidents between the municipalities that have implemented containers and those that have not. In the light green group, the cases of the 7 municipalities that implemented containers are represented (except for the year 2014 when containers were still not implemented). In the dark green group are represented the 6 municipalities that have not implemented containers.

As it is illustrated in [Figure 6](#), the municipalities which implemented containers had a decrease in the number of accidents, while in the municipalities which did not implement containers, the number of cases was increasing.

In [Table 1](#) were shown benefits of containerization in urban cleaning, based on the studies carried out by the Environment Department of Santos (2012); Brazilian Association of Urban Cleaning (2015); Contemar Ambiental (2018); Diniz et al. (2018) and Seabra et al. (2016).

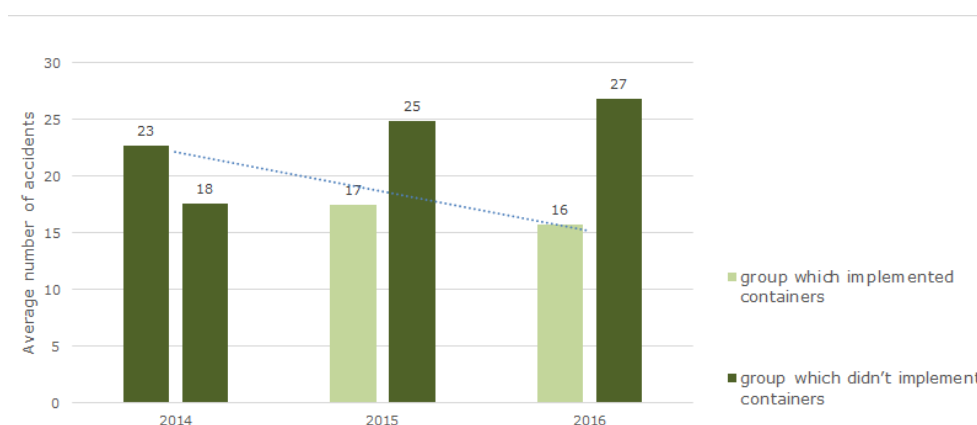


Figure 6. Average number of accidents between the group which implemented containers and the one which did not

As shown in [Table 1](#), the implementation of containers leads to various benefits for waste-collection workers and society. Containers reduce occupational accidents, presence of animals and disease vectors and improve the aesthetic look of the streets.

In the metropolitan region of Recife, it is common to organize “critical points”. Such points are use-to accumulate waste in a disorganized way, where bags are torn in the streets, waiting for its collection. With the implementation of containers, such points would be excluded as waste would remain enclosed within them, improving the landscape of the site, reducing the worker's effort and time necessary to collect waste, avoiding bad smell, the proliferation of diseases, among other benefits.

Table 1. Benefits of the container implementation (Adapted from the Environment Department of Santos (2012); Brazilian Association of Urban Cleaning (2015); Contempar Ambiental (2018); Diniz et al. (2018) and SEABRA et al. (2016)).

No.	Description
1	Elimination of unwanted odours, since the containers have lids that seal the bad smell.
2	Reduction and elimination of the incidence and proliferation of disease vectors and animals
3	Reduction in the number of occupational accidents, as the worker is not directly in contact with the waste.
4	It also reduces the number of times that collectors need to get on and off the truck.
5	Reduced operating time.
6	Reducing fuel consumption.
7	It avoids the contact of the population and workers with the waste.
8	Waste does not accumulate on sidewalks. Improve the aesthetic appearance of streets and sidewalks by placing bags inside containers, instead of being deposited on the streets.
9	Efficiency of waste segregation at source.
10	Improvement in collection efficiency.
11	Animals do not rip the bags with waste.
12	Protection of the bags from the weather.
13	Decreased clogging of manholes due to the bags that are taken when it rains, consequently reducing the probability of floods.
14	Residents can dispose of the waste 24 hours a day, not needing to wait for the time that the truck passes.
15	Elimination of environmental contamination resulting from improper disposal of waste on public roads.

3.3. General discussion

The conclusions made on analyzed data from company A and B converge with conclusions with similar previously conducted studies international and in Brazil, showing that sharp materials and falls represent leading causes of accidents (Oliveira, 2008; Soares, 2014).

One study stated that the falls are influenced by the velocity on which the waste collectors are transported on the backside platform (Jeong; Lee, S; Lee, J., 2016). It is important to notice that the recommendation from ANSI Z245 (2017), specify that during the collection of waste, the workers can transport themselves on it only on distance shorter than 322 meters and velocity lower than 16 km/h. The training of individuals transported on the platform, as well as its dimensions and materials are also regulated.

The following Table 2 shows the percentages of accidents with sharp materials, falls, the sum of the two major causes, other causes and the total number of accidents, representing results from studies which implemented with those which did not implement containers.

In grayscale were marked numbers of accidents in the municipality, which implemented containers, illustrating the decrease after its implementation.

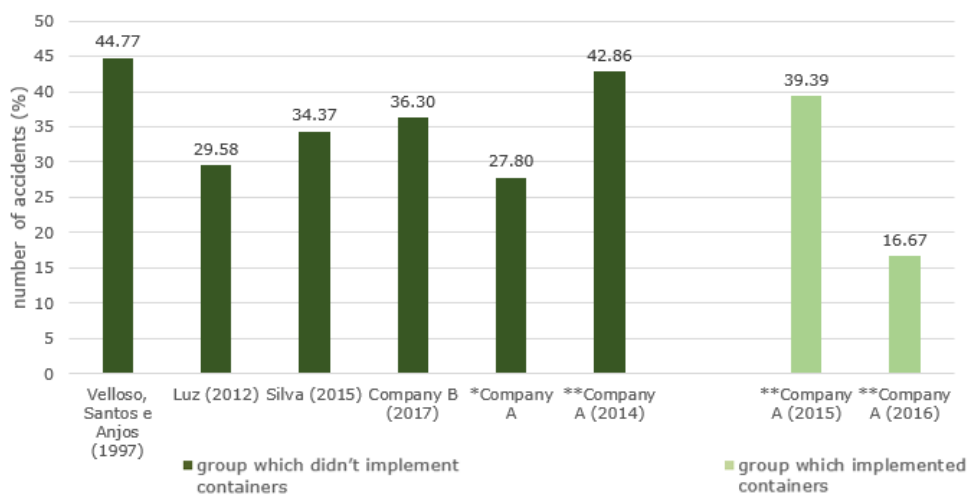
The studies used in Table 2 used a similar methodology to the one used in this study, comparing data gathered from different reports. Still, as each report had different subcategories, there might be some oscillation. It is important to point out that “other causes” increased after the implementation of containers from 12 (2014), to 15 (2015) and 19 (2016). The number of causes within this group was classified as “operational failure”, without any clear explanation on what does this group of causes include. This limits the interpretation of data, something which should be resolved in future studies.

Table 2. Major causes of accidents and containers implementation

Containers	Author/Company	Sharp materials		Falls		Total (sharp materials and falls)		Other causes		Total	
		Nr	(%)	Nr	(%)	Nr	(%)	Nr	(%)	Nr	(%)
No	Velloso, Santos e Anjos (1997)	30	44.77	6	4.47	36	49.24	31	50.76	67	100.00
	Luz (2012)	50	29.58	69	40.82	119	70.40	50	29.60	169	100.00
	Silva (2015)	11	34.37	7	21.87	18	56.24	14	43.76	32	100.00
	Company B (2017)	29	36.30	21	26.30	50	62.60	30	37.40	80	100.00
	*Company A	150	27.80	133	24.60	283	52.40	257	47.60	540	100.00
	**Company A (2014)	21	42.86	16	32.65	37	75.51	12	24.49	49	100.00
Yes	**Company A (2015)	13	39.39	5	15.15	18	54.54	15	45.46	33	100.00
	**Company A (2016)	5	16.67	6	20.00	11	36.67	19	63.33	30	100.00

* Company A = considering all accident cases in 13 municipalities during a period from 2014 to 2016; ** Company A = considering accident cases in the municipality which applied most containers, with no containers in 2014 and 766 containers in 2015 and 2016

Figure 7 shows a percentage of accidents caused by sharp materials based on the implementation of containers. Without containers, sharp materials caused between 27.8 and 44.77% of accidents.

**Figure 7.** Percentage of accidents caused by sharp materials based on the implementation of containers

* Company A = considering all accident cases in 13 municipalities during a period from 2014 to 2016; ** Company A = considering accident cases in the municipality which applied most containers, with no containers in 2014 and 766 containers in 2015 and 2016

The chosen municipality from company A shows that there was a decrease in the number of accidents caused by sharp materials from 2014 to 2015, and having its highest decrease in 2016. In order to fully understand how beneficial was the application of containers; it is important to observe not only percentages but also the number of accidents (represented in Table 2), which is a total amount decreased from 2014 (49 cases) when there were no containers, to 2015 (33) and 2016 (30) when the containers were applied.

Figure 8 shows a percentage of accidents caused by falls based on the implementation of containers. Without containers, falls usually caused between 21.87% and 40.82% of accidents. One exception was the study from Velloso, Santos, and Anjos (1997), which classify only 4.47% of cases to be caused by falls. After the implementation of containers, the number of cases caused by falls in the chosen municipality from company A decreased from 32.65% (2014) to 15.50% (2015) and 20% (2016).

Therefore, as illustrated in figure 8, the implementation of containers directly seems to influence the reduction of the number of cases caused by falls.

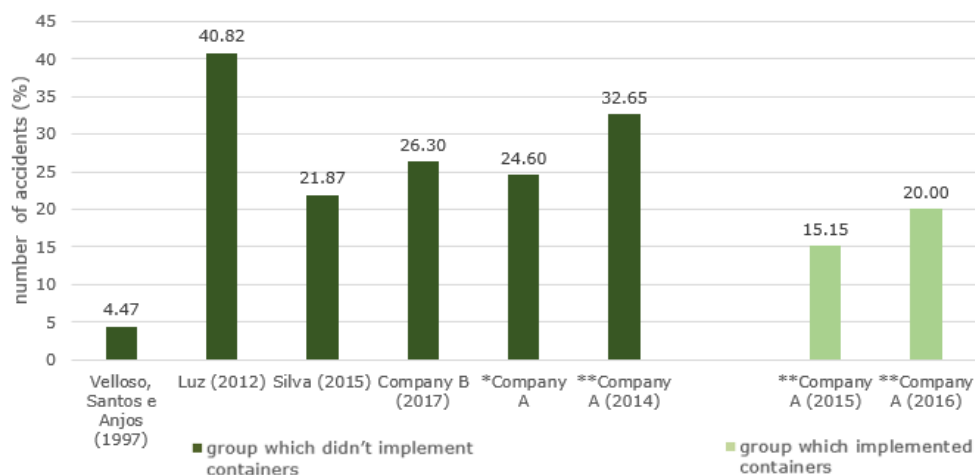


Figure 8. Percentage of accidents caused by falls based on the implementation of containers

* Company A = considering all accident cases in 13 municipalities during a period from 2014 to 2016; ** Company A = considering accident cases in the municipality which applied most containers, with no containers in 2014 and 766 containers in 2015 and 2016

Figure 9 shows a percentage of accidents caused by both sharp materials and falls based on the implementation of containers. As illustrated in figure 9, sharp materials and falls are major causes of accidents in the urban cleaning and waste collection, representing between 49.24 and 75.51% of all causes. Although the number of accidents and respective percentages show a decrease after the implementation of containers from 75.51% (2014), first to 54.54 (2015) and then to 36.67% (2016), those two causes remained the major cause of accidents in the whole group.

Although in a lower number, sharp materials (8.9%) were also a high risk identified in a study conducted in South Korea, specifying it as one of the principal types of accidents (Jeong; Lee, S; Lee, J., 2016). Falls, on the other hand, were identified by most of the studies as the primary type of accidents. Therefore, these should be the risks to be firstly addressed in future studies and urban waste collecting services.

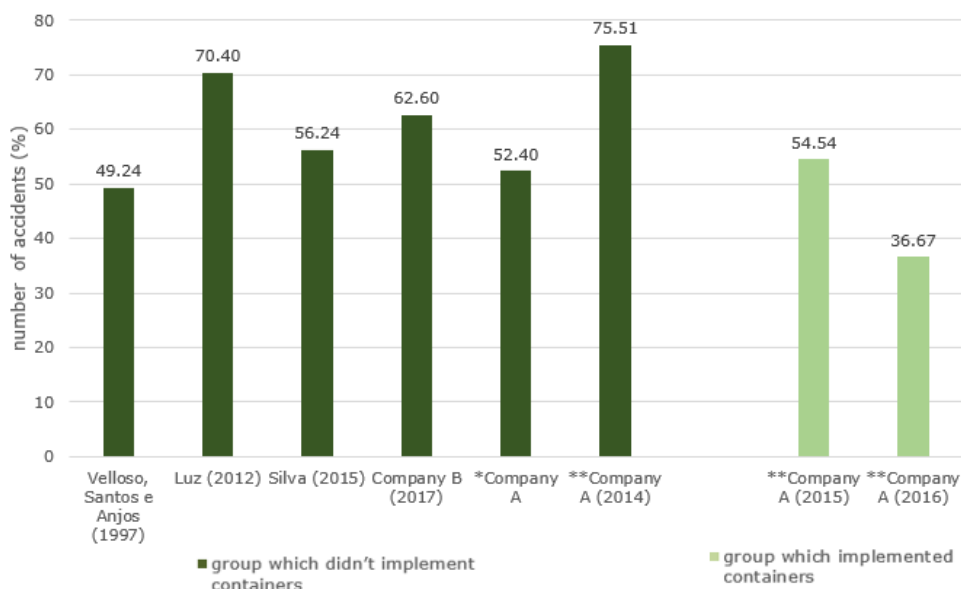


Figure 9. Percentage of accidents caused by sharp materials and falls based on the implementation of containers

* Company A = considering all accident cases in 13 municipalities during a period from 2014 to 2016; ** Company A = considering accident cases in the municipality which applied most containers, with no containers in 2014 and 766 containers in 2015 and 2016

For the implementation of containers, it is essential to plan and analyze the necessary demand of the city. Further on, for that purpose, it is necessary to conduct more

thorough analyses of when and how work accidents occurred during the waste-collecting process. Finally, future studies should focus on the reduction of the major accidental causes, where falls represent one of them and investigate if falls usually occurred from the truck or in the standing or running position. Falls from trucks should be additionally screened in order to find out if in those cases, the trucks had all its parts (for example platforms and handholds) were appropriately built (considering the material type and dimensions) and certified for the transportation of workers. Further-on, future studies could investigate if there was a protocol applied when transporting workers if there was a limitation of driving speed while the workers were transported on the platform, if workers had adequate training and if everything was done according to standards for the waste-collection process.

4. CONCLUSIONS

The urban cleaning service is essential for society. The household waste production is continuously increasing, consequently the investment in the urban cleaning sector. Nevertheless, as there is a need to invest even more in order to reduce the number of occupational accidents.

According to the analyzed data, the household collection was the type of service with the highest number of accidents with 65.61 of the total number of accidents. The sharp materials and falls were the main causes of accidents, accounting for 53% of accidents in the company A and 62% in the company B.

After containers implementation, the data from one municipality show a reduction in the number of accidents caused by sharp materials and falls from 37 without the container in 2014, to 18 with the container in 2015, and 11 with the container in 2016.

The reduction in the number of accidents can be explained with the implementation of the containers. Containers reduced the direct exposure of the worker to the waste, reducing the exposure to sharp materials and reducing the chance of falling or tripping during the operation.

Several suggestions for future studies were given in the discussion part, mainly concerning the leading causes of accidents.

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REFERENCES

- ABLP, Associação Brasileira de Limpeza Urbana. (2015). "Coleta Mecanizada." *Revista Limpeza Pública* 90: 31–39.
- ABNT, Associação Brasileira de Normas Técnicas. (1993). NBR 12.980: Coleta, varrição e acondicionamento de resíduos sólidos urbanos.
- ABRELPE, ASSOCIAÇÃO BRASILEIRA DE EMPRESAS DE LIMPEZA PÚBLICA E RESÍDUOS ESPECIAIS. (2017). *Panorama dos Resíduos Sólidos no Brasil 2017*. www.abrelpe.org.br (accessed: 21 jun 2019)

- ANSI, AMERICAN NATIONAL STANDARDS INSTITUTE. (2017). ANSI Z245.1-2017: Mobile Wastes and Recyclable Materials Collection, Transportation, and Compaction Equipment. <https://webstore.ansi.org/standards/eia/ansiz2452017> (accessed: 08 nov 2019).
- Contemar Ambiental. (2018). "Coleta Mecanizada." <http://www.contemar.com.br> (accessed: 23 ago 2018).
- Diniz, N.; Castro, P.; Lago, E.; Da Cruz, F.; Zlatar, T.; Wasnievski, D.; Pereira, A.; Barkokébas Junior, B. (2019) Work-Related Accidents in Urban Solid Waste Collection. In: Arezes P. et al. (eds) Occupational and Environmental Safety and Health. Studies in Systems, Decision and Control, vol 202. Springer, Cham. <https://doi.org/10.1007/978-3-030-14730-3>.
- Diniz, N.; Barkokébas Junior, B.; Zlatar, T.; Da Cruz, F.; Lago, E. (2018). Segurança do trabalho, produtividade e qualidade: Análise da coleta de resíduos sólidos urbanos. XXXVIII Encontro Nacional de Engenharia de Producao (ENEGEP). Maceio, Alagoas.
- Canadian Union of Public Employees (CUPE). (2019). Health and Safety. Disponível em: <https://cupe.ca/> (accessed: 08 nov 2019).
- Eigenheer, Emílio Maciel. (2009). A História Do Lixo: A Limpeza Urbana Através Dos Tempos. <http://www.lixoeeducacao.uerj.br/imagens/pdf/ahistoriadolixo.pdf> (accessed: 22 Jun 2019).
- Eskezia, D et al. (2016). Prevalence and associated factors of occupational injuries among municipal solid waste collectors in four zones of Amhara region, Northwest Ethiopia. BMC Public Health 16 (1): 862.
- Flores, L; Carvalho, D; Radon, K. (2018). 1347 Hazardous work: a look at the safety and health at work of garbage collectors in Asuncion, Paraguay, 2013–2014. Occupational and Environmental Medicine 75 (2): 1.
- Jeong, B. Y; Lee, S.; Lee, J. (2016). Workplace Accidents and Work-related Illnesses of Household Waste Collectors. Safety and Health at Work 7 (2): 138-142.
- IBGE - Instituto Brasileiro de Geografia e Estatística. (2013). "Cidades." 2013.
- Luz, L.(2012). Segurança e saúde do trabalhador em serviços de limpeza urbana : estudo de casos.Campinas, SP.
- Oliveira, M.(2008). Características organizacionais e acidentes ocupacionais em empresas de limpeza urbana em Salvador-BA. Programa de pós-graduação em saúde coletiva. Salvador.
- Recife. Secretaria das cidades. (2011). "Plano Metropolitano de Resíduo Sólido – RMR."
- Seabra, L. H. C.; Gallep, R.; Gonçalves, D. B.; Alternativas para coleta e disposição final de resíduos sólidos em municípios de pequeno e médio porte. Revista da Universidade Vale do Rio Verde, Três corações, v. 14, n. 2, p. 614–26, 2016.
- Secretaria Nacional de Saneamento Ambiental. (2008). "Saúde e Segurança Do Trabalho Em Serviços de Saneamento." ReCESA Nível 1. Salvador: 36.
- Secretaria de Meio Ambiente de Santos. (2012). Plano de Gestão Integrada de Resíduos Sólidos Do Município de Santos.
- Soares, D. (2014). Análise dos riscos ocupacionais e acidentes de trabalho em catadores de resíduos sólidos em cooperativas de Ceilândia – DF. Vol. xii, pp. 51. Saúde Coletiva. Brasília.
- Silva, F.(2015). Análise de riscos dos trabalhadores da coleta de resíduos sólidos domiciliares do município de Curitiba - PR. Curso de Pós Graduação em Engenharia de Segurança do Trabalho, Universidade Tecnológica Federal do Paraná – UTFPR. Paraná.
- Tibbetts, J. (2013). Garbage collection is 'one of the most hazardous jobs'. Canadian Medical Association Journal, [S. I], n. 7, v. 185, p. 554.
- United States ff America. (2017). Bureau of labor statistics. National census of fatal occupational injuries in 2017. Washington: Bureau of labor statistics. <https://www.bls.gov/news.release/pdf/cfoi.pdf>. (accessed: 08 out. 2019).
- Velloso, M. P., E. M. Santos, and L. A. Anjos. (1997). "Processo de Trabalho e Acidentes de Trabalho Em Coletores de Lixo Domiciliar Na Cidade Do Rio de Janeiro, Brasil." Cad. Saúde Públ 13 (4): 693–700.