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GARBAGE COLLECTORS: OCCUPATIONAL ACCIDENTS AND COEFFICIENTS OF FREQUENCY AND SEVERITY PER ACCIDENT*

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Abstract: The present study was conducted in order to determine the number of occupational accidents (OA), the Coefficient of Frequency per OA (CFOA) and the Coefficient of Severity per OA (CSOA) among garbage collectors in a Brazilian town, as well as to determine the incidence of these events and their characteristics. The data were obtained from the notifications of OA sent to the National Institute of Social Security and from the company employing the workers. A total of 103 OA occurred over a period of 12 months among 81 workers. The CFOA was 527 and the CSOA was 6722 per 1,000,000 working man-hours. The major cause of OA was improper garbage wrapping; the lower limbs of the workers suffered most of the injuries; the most frequent medical diagnoses were wounds, cutting-contusion injuries, cutting injuries, and excoriations. The accidents were more frequent at the beginning of the week and after two to three and four to five hours of work. As carried out in this town, this type of work provokes risks and favors the OA detected. The garbage collectors should receive more attention from their employer. In view of the social importance of this type of work, the authorities responsible for the inspection of working conditions should be more rigorous with the company in question.

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Key words: occupational accidents, garbage collectors, Coefficient of Frequency, causes of occupational accidents, body parts injured in occupational accidents.

INTRODUCTION

Urban cleaning services tend to become increasingly complex as the urban population increases. Understood as a risky activity of maximum insalubrity because of the contact with agents that are harmful to health, as reported by Ducel *et al.* [3]; Oliveira [13] and Pacheco [15], garbage collection with trucks is routinely executed in Brazil by predominantly male workers who earn one to three minimum wages [2, 7, 16, 18, 20, 21]. The basic requirements for a good working performance on the part of garbage collectors should involve an appropriate salary policy and the development of human resources, as recommended by the Pan-American Health Organization [14]. Remuneration should be higher than that of other workers who do not perform such insalubrious tasks [19]. However, these requirements do not seem to be considered by the Brazilian companies employing these workers, as reported by Robazzi *et al.* [18] and Ilário [7].

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The workers use an accelerated rhythm of work described by Ilário [7] as "precipitous running". They carry several garbage bags at the same time, holding them with their hands, under their arms or resting on their chest, with a consequent increased possibility of suffering OA due to cutting lesions, muscle alterations or even problems related to spinal sprains caused by carrying excessive weight. Robazzi *et al.* [18] observed that very often the garbage collectors would run along the public streets in a zig-zag pattern, since the tools and the garbage bags are left on the ground or at higher levels on the sidewalks both on the left side of the road and on the right side where the truck runs. The truck would stop or move, often very slowly but sometimes fast, usually occupying all the space destined to the other vehicles. The attitude of car drivers usually was to honk the horn and to try risky passing even by climbing into the sidewalk, endangering the physical integrity of the workers and of the pedestrians. These and other similar behaviors were also observed by Silva *et al.* [21] who reported the possibility of accidents involving the workers who could be run over, with the occurrence of mutilation and even death.

Occupational Accidents (OA) can also occur due to maneuvers with vehicles, exposure to dust, fire and explosions, animal bites, different types of cuts and contusions [5]. Robazzi *et al.* [18] showed that 75% of the garbage collectors studied by them were dismissed from work due to these events. Faria *et al.* [4] reported that of the total number of 4095 OA detected in their study, 2.1% involved street sweepers, garbage collectors and weeding duties (people responsible for removing weeds from the cracks of city sidewalks). Ilário [7] reported an incidence of 137 accidents in 1985 and 152 in 1986, numbers calculated per 100 collectors/year, and many of the OA were considered serious. Chaumont *et al.* [1] mentioned that accidents among garbage collectors occur because of the material handled, because of traffic and other causes; Silva [20] detected contusions, wounds and sprains as the most frequent OA affecting the lower and the upper limbs of these workers. Pereira [16] also reported accidents involving hands and feet as those most frequently detected in her study. The precarious conditions of these workers are not justified because, according to Ilário [7], simple measures could be of benefit, such as admission medical examinations, health education especially in the area of the prevention of alcoholism, basic immunizations, and others.

In view of these considerations, it can be seen that the situation of garbage collectors in the town under study is undesirable and incompatible with what is understood as dignity on the workplace. The objective of the present study was to determine the number of OA that occurred among garbage collectors, the coefficients of frequency and of severity per OA, as well as some of the OA characteristics such as their causes, body parts injured by them, the diagnoses made by the doctors who provided care for the victims, the days of the week when OA were more frequent and the number of hours the collectors had been working before the occurrence of the OA.

MATERIAL AND METHODS

The study was carried out in Ribeirão Preto, State of São Paulo, Brazil, a medium-sized town of approximately 500,000. The objective of the investigation was to determine the OA that occurred in the urban region of this town among garbage collectors. The information about the accidents referred to a period of 12 months and was obtained from the Sector of Benefits Payment of the National Institute of Social Security (INSS) and from the company responsible for urban cleaning. At the INSS we consulted the Communications of Occupational Accidents (COA) emitted by the company and copied the necessary information. At the company we obtained the number and the names of workers in this service during the study period and who were at risk of suffering OA, as well as the dates of their admission and dismissal.

To determine some frequency distributions, the following coefficients were used [20]: Coefficient of Frequency per OA, i.e., the number of accidents with loss of working time per million man-hours of work (CFOA), and Coefficient of Severity per OA, i.e., the number of days lost and days debited per million man-hours of work (CSOA). The number of man-hours of work (MHW) was calculated as follows: MHW = total number of days × mean number of MHW per day. The estimate of number of MHW per day is explained as follows: in each month, the number of workers may suffer a small variation due to dismissals or admissions. Thus, it may occur that the number of workers at the beginning of the month will be slightly different from the number of workers at the end of the month. Since access to information at the company was limited, we could not determine exactly on what days of the month the workers were admitted or dismissed, nor was it possible to find out the number of hours worked by each of these admitted or dismissed workers. To compensate for this lack of information, we estimated the number of workers per month. On the basis of available data, the estimator was considered to be the mean value of the number of workers present at the beginning and at the end of the month.

The estimate of the number of MHW worked per day (MHW$\underline{d}$) in a given month $\underline{i}$ was then as follows: MHW$\underline{di}$ = (n1 + n2) $\underline{h}$/2, where n1 is the number of workers at the beginning of the month and n2 the number of workers at the end, $\underline{h}$ is a constant, the number of working hours per day (8 hours in this case), and $\underline{i}$ is the index corresponding to the month in question. The estimate for the number of MHW in the month (MHW$\underline{i}$) was: MHW$\underline{i}$ = T$\underline{i}$ × MHW$\underline{di}$, where T$\underline{i}$ is the number of working days in the month. To calculate the CFOA we used the estimate of the total MHW for the 12 months of observation as follows: CFOA = ($\underline{n}$/MHW) × 1,000,000 where $\underline{n}$ is the number of OA in the 12-month period, and MHW is the estimated number of MHW in the 12-month period. The CSOA was calculated using the following equation: CSOA = ($\underline{t}$/MHW) × 1,000,000 where $\underline{t}$ is the time computed (days lost at the company per OA + debited days) and MHW is the estimated number of MHW in the 12 month period.

Table 1. Distribution of garbage collectors employed by the company responsible for urban cleaning according to month of admission and month of dismissal during a period of 12 months and number of working days per month.

Number of month (i)	Months	Beginning of month	Number of workers admitted	Number of workers dismissed	End of month	Number of working days per month (Ti)
1	Jan	82	39	21	100	26
2	Feb	100	11	22	98	22
3	Mar	89	36	34	91	25
4	Apr	91	25	47	69	26
5	May	69	31	18	82	25
6	Jun	82	9	20	71	25
7	Jul	71	29	27	73	27
8	Aug	73	28	24	77	27
9	Sept	77	14	13	78	24
10	Oct	78	12	13	77	26
11	Nov	77	10	6	81	24
12	Dec	81	9	8	82	25
	Total		253	253		

RESULTS

A total of 103 OA suffered by 81 garbage collectors were notified by the company. The CFOA and CSOA were calculated as indicated below. The data in Table 1 were used for the calculation.

On the basis of these data, we estimated the number of workers per month: January: 91; February: 99; March: 90; April: 80; May: 75.5; June: 76.5; July: 72; August: 75; September: 77.5; October: 77.5; November: 79; December: 81.5. The following MHW$\underline{i}$ estimates were obtained: Jan: 18,928; Feb: 17,424; Mar: 18,000; Apr: 16,640; May: 15,100; Jun: 15,300; Jul: 15,552; Aug: 16,200; Sep: 14,880; Oct: 16,120; Nov: 15,168; Dec: 16,300. The sum of the numbers of MHW$\underline{i}$ over the 12-month period, $\underline{i}$ = 1 , 2 , ..., 12, was 195,612.

The CFOA was calculated using the total estimated MHW for the 12 months of observation (195,612) and the number of OA for these months (103), as follows: CFOA = (103/195,612) × 1,000,000 = 527. The CFOA for the company was, therefore, 527 accidents per 1,000,000 MHW. The CSOA was estimated as follows: t = number of days lost at the company per OA: 1315 days (sum of the number of days lost due to the OA that occurred during the 12-month period) + number of days debited: 0; MHW = 195,612. Thus, the CSOA = (1315 + 0) /195,612 × 1,000,000 = 6722 per 1,000,000 MHW.

The causes of OA were divided into seven groups: “garbage wrapping” (24 accidents, 23.3% of the total) included the descriptions on the COA of cutting or perforating objects or objects that caused the plastic bags

Table 2. Distribution of occupational accidents among 81 garbage collectors according to body parts injured, mentioned by the company and cited in the medical diagnoses, described on the COA.

Body parts injured	Medical Diagnosis	
	No	%
Lower limbs	67	(65.0)
Upper limbs	18	(17.5)
Spine	8	(7.7)
Thorax	1	(1.0)
Face	1	(1.0)
Skull	1	(1.0)
Elbow and skull	1	(1.0)
Foot, face, hand	1	(1.0)
No information available	5	(4.8)
Total	103	(100.0)

Table 3. Distribution of occupational accidents among 81 garbage collectors according to the medical diagnoses reported on the COA.

Medical diagnosis	Occupational accidents	
	No	%
Wound, cutting-contusion injury, cutting injury, excoriation	30	(29.1)
Tenosynovitis, tendinitis	25	(24.3)
Trauma, contusion, hematoma, ecchymosis	17	(16.5)
Ligament injury, contracture, sprain, crepitation	9	(8.7)
Lumbalgia	8	(7.8)
Fracture	4	(3.9)
Other	4	(3.9)
Pain	1	(1.0)
No information available	5	(4.8)
Total	103	(100.0)

to be too heavy, often breaking them; “collecting truck” (23, 22.3%) included accidents involving the running board, rudder and hooks; “public street” (20, 19,4% of the total) included the description of holes, rocks, differences in level between sidewalk and pavement, excessively elevated gutters or gutters consisting of sharp stones. “Traffic” (4, 3.9% of the total) included the collision between cars and workers, falls to the ground due to collisions with bicycles and motorcycles and similar occurrences; “other” (6 accidents, 5.8% of the total) included animal bites, aggression by pedestrians, fights among workers or causes that were not related to the description of the OA. “Inherent in the worker” (3, 2.9%) included causes such as headache, malaise, nausea, loss of balance by one worker causing him to lean on another who then suffered an accident; “no information available” (23, 22.3% of the total) referred to the situations in which the company did not fill out the causes of the OA on the COA.

The body parts that were injured due to the OA are listed in Table 2 and the diagnoses made by the doctors who provided care for the accident victims are listed in Table 3.

Most of the accidents occurred on Mondays (24.9%) and Tuesdays (20.4%); 16.1% of the accidents occurred on Thursdays and 14.1% on Saturdays. With respect to the number of hours of work before the occurrence of an OA, 8.76% of the accidents occurred from zero to one hour after the beginning of the day's work, 9.5% from one to two hours, 18.3% from two to three hours, 13.9% from three to four hours, 15.8% from four to five hours, with the percentage decreasing thereafter. In 2.9% of the COA there was no record of the number of hours of work before the occurrence of an OA.

DISCUSSION

A comparison of the CFOA and CSOA data showed that those obtained by Silva [20], who studied OA that occurred among garbage collectors in the city of São Paulo (the largest in the country in terms of area and population) mostly involved higher rates than those detected in the town of Ribeirão Preto. The CFOA for 1966, 1968 and 1969 calculated by Silva [20] were 541, 729 and 558, respectively, as opposed to the 527 value obtained in the present study. The CSOA values obtained by Silva [20] were also higher than our 6722 estimate. Among the publications concerning garbage collectors [5-9, 11, 12, 18, 19] only that published by Silva [20] reported these coefficients. We believe that these numbers may vary due to different factors such as geographic area, age, gender, socioeconomic conditions, race, and even time of the study. The study by Silva [20] was carried out in a large metropolis (São Paulo) a few years ago. It is difficult to make comparisons without taking into account the differences in the organization of garbage collection between São Paulo at that time and Ribeirão Preto today, and the differences between the workers in the two towns. Silva [20] found the occurrence of deaths among garbage collectors which increased the CSOA value, a situation that did not occur in the present study. In view of these considerations, we believe that the lower values found among the Ribeirão Preto collectors do not necessarily indicate that their work is less dangerous or risky compared to the city of São Paulo.

The major cause of OA was improper garbage wrapping. The presence of perforating or cutting objects of inadequate size in relation to the plastic bags and of excessively heavy objects, which often tear the bags, is a common fact in this town. Marques *et al.* [11] also observed that the public cleaning sector had a large number of OA mostly provoked by inappropriate garbage wrapping in plastic bags. The garbage collectors handle the bags often without any protective equipment (gloves and/or shoes), a fact that favors OA. The garbage collecting truck also was found to be an important cause of OA. The running board of the vehicle, located about 45 cm from the ground, causes the worker to hit it when running after the truck; OA were also caused by the rudder, a device controlled by the driver which, when activated, pushes the plastic bags into the compacting compartment. On many occasions the workers help the rudder with their hands and arms to push the bags more rapidly, an attitude that favors the risk of accidents. The hooks of the vehicle provoke OA especially affecting the hands when the collectors connect the hooks to metal tanks containing the garbage. Ilário [7] found serious OA among garbage collectors, also caused by falls off the vehicles. The number of OA occurring on the public streets is also important. Since the workers do not use appropriate shoes, it is easy to see that they may fall, take a “false” step, and slip when they run or walk fast after the truck. The number of OA of unknown causes due to incomplete filling of the COA prevented a more precise analysis of this information.

Table 2 shows that the lower limbs were the most injured, followed by the upper limbs and the spine. By walking fast or running to drop the garbage bags into the truck, the workers injure themselves by rubbing the bags against thighs and legs. They frequently hit their legs against the running board when they try to jump from the ground to the moving collecting truck without wearing appropriate shoes. Since they do not wear gloves, they also cut or perforate their hands. Pereira [16], Silva [20] and Silva *et al.* [21] also reported that accidents involving feet and hands were the most frequent among these workers. Grieco *et al.* [6] reported that OA mostly involved the hands of the garbage collectors studied by them. In Ribeirão Preto these workers do not wear long pants but rather bermudas supplied by the company. This type of clothing is inadequate because it favors the occurrence of leg injuries, a fact that may explain the higher frequency of OA in this part of the body.

With respect to spinal injuries, inappropriately wrapped garbage with the presence of heavy objects requires a greater muscular effort on the part of the collectors and tends to cause the onset of inadequate posture when they lift the bags. Menoni *et al.* [12] reported that there is

evidence of significant risks for workers who carry garbage bags, especially for the lumbar tract of the spine; Pereira [16] detected herniated posterior disks in the lumbar region. In addition to chest injuries that may be explained by the fact that the garbage collectors unbutton their shirts during work, and face injuries, especially to the eyes due to fragments projected from the garbage bags ruptured by the rudder, there were also some episodes for which neither the company nor the doctors mentioned the injured part of the body.

The more frequent medical diagnoses referred to wounds, cutting-contusion injuries, cutting injuries and excoriations and were also made by some investigators [5-7, 11, 20]. Because of the way the work is performed and because of the presence of objects inside the garbage bags that may inflict wounds, the predominance of this type of medical diagnosis may be easily understood. There was also the occurrence of tenosynovitis and tendinitis, probably due to the weight of the garbage bags and the inappropriate way the collectors hold them when they make rapid movements required by the high speed of their work. Trauma, contusions, hematomas and ecchymoses, ligament injuries, contractures, sprains and crepitations and lumbalgia have been reported to be expected among garbage collectors, although not always in the order of frequency detected here. These problems probably occur because of the manner the work is performed in the town under study. Forattini [5] observed that inappropriate postures and continuous physical effort result in several of the problems described here. According to Lascoe [10] alterations in muscles, tendons and ligaments, especially distension of the dorsal muscles, frequently occur among garbage collectors, as also reported by Ilário [7], Menoni *et al.* [12] and Pereira [16], among others. The COA that were not filled out properly impaired the analyses, with their percentage even exceeding some of the diagnoses attributed to the OA.

The days of the week when the accidents occurred more frequently were the first ones, i.e., Mondays and Tuesdays, with a new increase on Thursday and a decrease in the remaining days. These results are similar to those reported by Pereira [16], who reported that the first four days of the week are those when the garbage collectors suffer more accidents. The accumulation of garbage at the end of the week may explain the high frequencies of OA on Mondays and Tuesdays. Since garbage collection is made on alternate days, with time off on Sundays and holidays, the last day of collection is Saturday. Garbage accumulates at the beginning of the week because of the production and lack of collection on Sundays. In some neighborhoods, garbage is collected on Mondays, and in others on Tuesdays, and this accumulated volume favors the OA. At the beginning of the week, the workers probably work faster than on the days in the middle of the week in order to finish their task on time. When the relationship between garbage production and collection during the week is normalized, the number of accidents tends to decrease. The fatigue caused by the rhythm of the work may favor OA on Thursdays. This occurrence might probably be minimized if the company effectively supervised the work of these men and regulated their time of leaving regardless of the time they take to finish their work in the collection sector under their responsibility. We believe that this would be a way to reduce the speed of execution of the garbage collectors' work, with a consequent possible reduction also of OA.

With respect to the number of working hours before the occurrence of OA, the period between 2 and 3 hours and 4 and 5 hours was that of highest OA incidence. It is difficult to explain these data since the times of the shifts of these workers are unknown. Consequently, we do not know whether they were more exposed to the risk of suffering OA during the night shift than during the day shift on the basis of factors that may occur more frequently in one shift than the other and possibly affect the incidence of OA. Fatigue may also have contributed to the occurrence of these events. During the first four hours, the sum of the frequencies of OA detected (50.4%) was higher than during the last four hours of the workshift (42.8%). Also, for 2.9% of the OA there was no record of the number of hours of work on the COA. We may propose that during the first hours of work, facing the extension of the sector to be cleaned, the large number of garbage bags to be collected, the large number of working hours ahead, the collector will execute his work more rapidly in order to complete his task in time. This fact, however, may contribute to the occurrence of more accidents than when the work is executed at a lower speed, a fact possibly occurring in the final hours of the workshift.

CONCLUSIONS

We consider the CFOA of 527 per 1,000,000 MHW and the CSOA of 6722 per 1,000,000 MHW to be high. Although we compared our data with those obtained in a study that reported this value, we did not find a study carried out on towns with characteristics similar to those of Ribeirão Preto. A total of 103 OA occurred among 81 garbage collectors; the major cause of the accidents was improper garbage wrapping. The body parts most often injured were the legs, followed by the arms; the diagnoses most frequently made by the doctors were wounds, cutting-contusion injuries, cutting injuries, and excoriations. The early days of the week seemed to favor a higher frequency of OA than other days; the first four hours of work seem to have favored a higher occurrence of OA.

More attention should be paid to these workers. This insalubrious working activity carried out in an inadequate manner because of how the work is organized, with apparently little or no supervision, favors the occurrence of accidents. Educational programs should be directed at the workers themselves, with adequate training for the job, appropriate awareness of the risks of the job and of the health problems that may arise, with the need to use protective equipment. The company should be concerned

about examining the causes of these accidents, thus reducing the causative factors related both to the workers and to the company itself.

Other measures such as inspection of the company on the part of existing and appropriate official organs, as well as the hiring of personnel with qualification in occupational health and safety who may promote effective education for workers and also for the employers themselves, should also be taken in order to reduce the frequency of OA detected in the present study.

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