

# Occupational hazards of Brazilian solid waste workers: a systematic literature review

Riscos ocupacionais em trabalhadores da limpeza urbana no Brasil: uma revisão sistemática da literatura

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**ABSTRACT | Background:** In Brazil, urban cleaning professionals play an important role within a context characterized by annual increase of the garbage production. However, the job exposes such workers to various occupational hazards, an issue little discussed in the literature. **Objective:** To identify occupational hazards to which Brazilian solid workers are exposed, as well as factors associated with their minimization. **Methods:** A systematic review of the literature was performed in databases Scientific Electronic Library Online (SciELO), Latin American and Caribbean Literature in Health Sciences (LILACS), and PubMed. Gray literature was also searched through Google Scholar and included studies published along a ten-year period (2006-2016) in Portuguese, English, and Spanish. **Results:** Twelve studies were located; the results showed that waste workers were exposed to biological, accidental, chemical, ergonomic, physical, and psychosocial risks. The risks declined with adherence to use of personal protective equipment and guidance for workers, employers, and population. **Conclusions:** Given the few studies in this field, more evidence-based research is necessary to serve as grounds for the development and implementation of public health policies aiming at reducing occupational risks among the studied population.

**Keywords |** solid waste; occupational risks; public health; occupational health.

**RESUMO | Contexto:** No Brasil, os profissionais de limpeza urbana desempenham um papel importante em um contexto em que a produção de lixo no país aumenta consideravelmente a cada ano. No entanto, esse trabalho expõe tais trabalhadores a vários riscos ocupacionais, sendo essa questão pouco discutida na literatura. **Objetivo:** Identificar os riscos ocupacionais aos quais esses trabalhadores estão expostos e fatores associados à sua minimização. **Métodos:** Realizou-se uma revisão sistemática da literatura utilizando as bases de dados Scientific Scielo, Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS) e PubMed. A literatura cinza também foi consultada através do Google Scholar e incluiu estudos publicados em um recorte de dez anos (2006-2016) em português, inglês e espanhol. **Resultados:** Doze estudos foram identificados e seus resultados mostraram que os trabalhadores de resíduos estão expostos a riscos biológicos, de acidentes, químicos, ergonômicos, físicos e psicossociais. Os riscos diminuem com a aderência a Equipamentos de Proteção Individual e orientação aos trabalhadores, empregadores e população. **Conclusão:** Dada a escassez de estudos neste campo, há a necessidade de mais pesquisas baseadas em evidências que possam servir de subsídio para o desenvolvimento e implementação de políticas públicas de saúde visando a redução dos riscos ocupacionais no grupo estudado.

**Palavras-chave |** resíduos sólidos; riscos ocupacionais; saúde pública; saúde do trabalhador.

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## INTRODUCTION

Each year, about 1.3 billion tons of solid waste are generated worldwide. By 2025, this volume is expected to reach up to 2.2 billion tons annually, which is a cause of concern for governments and society<sup>1</sup>.

Brazil is one of the nations that produces the largest amount of waste, following the increase of its population (currently 200.4 million) each year<sup>2</sup>. The country generates nearly 80 million tons of solid waste per year, being elected as the third largest waste producer in the planet<sup>3</sup>. The situation is more concerning due to the fact that professionals involved with waste collection in the country do not receive the attention deserved by municipal authorities or attributable respect from the society<sup>4</sup>.

In Brazil, the job of garbage professionals requires much effort to be accomplished, given the nature of the work, workplace conditions, besides predictable and unpredictable variables that follow their routine<sup>5</sup>. It is contended that those professionals are exposed to a variety of occupational hazards<sup>6</sup>, most of them not discussed within scientific literature in a context where such individuals face social stereotyping as an effect of cultural influences<sup>7</sup>.

Thus, guided by the research question "What are the occupational hazards to which solid waste workers are exposed in Brazil?", a systematic review was conducted in order to identify occupational hazards that affect those professionals as well as factors associated with hazard minimization in this group.

## METHODS

### STUDY DESIGN AND SEARCH STRATEGY

A systematic review of national and international literature was conducted which aimed to identify occupational hazards that affect Brazilian waste workers, as well as the factors that contribute to the minimization of hazards in the given population.

Data were collected from November to December of 2016 in two distinct, respective stages (S1 and S2). For S1, three authors performed an independent search on the electronic databases: Scientific Electronic Library Online (SciELO), Latin American and Caribbean Literature in Health Sciences (LILACS), and PubMed. On the other end of the spectrum, for S2, the three researchers searched gray literature studies through *Google Scholar*, considering the small number of publications on the topic yielded from the electronic search.

For both stages and all databases, the following search strategy and terms were used:

1. Waste worker AND Occupational hazard OR Occupational risk;
2. Solid waste worker AND Occupational hazard OR Occupational risk;
3. Garbage worker AND Occupational hazard OR Occupational risk; and
4. Waste management AND Occupational health OR Occupational hazard OR Occupational risk.

### ELIGIBILITY CRITERIA

Complete studies published between 2006 and 2016 in English, Portuguese, or Spanish were considered for analysis as long as they had the primary purpose of examining occupational hazards in Brazilian waste workers. The authors did not include literature reviews or studies whose subjects were not legally employed waste professionals (i.e. homeless persons or individuals from non-governmental organizations collecting garbage for personal or community purposes). Studies on individuals involved in recycling were also not considered.

### STUDY SELECTION AND DATA EXTRACTION

For the selection of studies, instructions provided by Moher et al. in *Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement*<sup>8</sup> were followed. Once eligible literature was identified, they were exported to *Mendeley*, a reference manager, in order to organize titles by author and year of publication, excluding duplicates.

Eligible studies were read in full text and relevant data were extracted. Reference lists were also assessed. Finally, quantitative and qualitative data were segregated into categories for analysis. Microsoft Office Excel was utilized for further graphic representation.

## RESULTS

### REVIEW OF PAPERS

For this systematic review, the electronic and gray literature search yielded a total of 76 documents, which gave us an initial idea of the small number of publications on the topic. Only 57 studies remained after exclusion of duplicates. Then, the literature was screened for relevance after reading their titles

and abstracts, and 18 publications remained. However, not all of the remaining publications met the inclusion criteria, leaving the final number of studies to 12, which then had their reference lists screened with no more studies included (Figure 1).

## STUDY CHARACTERISTICS

The few studies identified in the database search and in the gray literature are presented in chronological order and include information about author/year of publication, method, objective, and results. The selected papers were mostly cross-sectional studies (92%), with a quantitative approach (Chart 1).

In a chronological analysis, one study dealing with occupational hazards in urban waste collectors<sup>9</sup> was identified for the year of 2006. However, no studies on the topic published in 2007 were identified. In 2008, there was one publication<sup>14</sup> and for each of the two subsequent years there were two publications<sup>10,15-17</sup>. It was possible to identify a single publication on the subject being published in 2011<sup>11</sup> and two in the following year<sup>18,19</sup>. In 2013, 2014, and 2015, there were no published studies

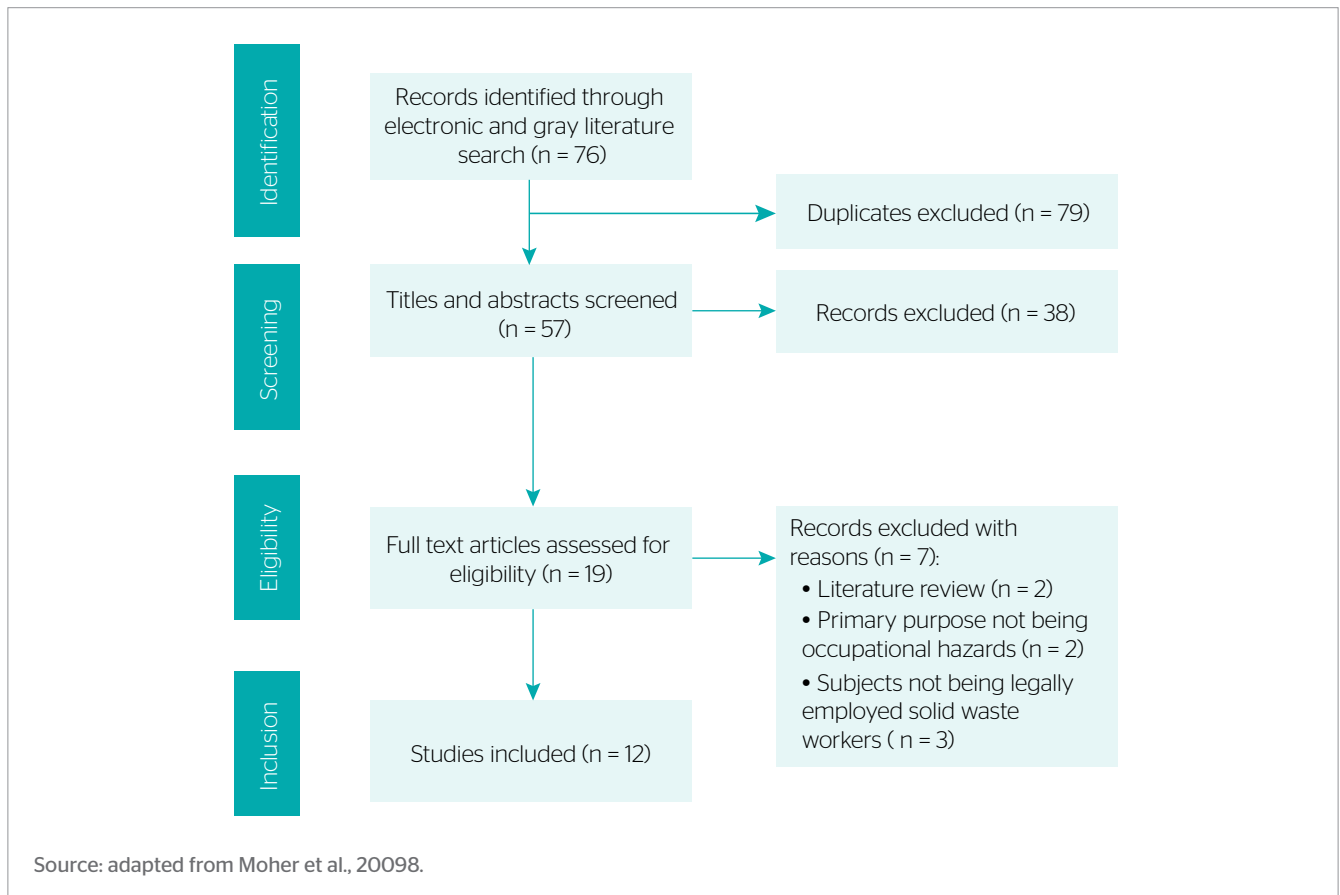
on the topic. Nevertheless, for 2016, three studies were encountered<sup>12,13,20</sup>. The fact points out a constancy in the number of published studies on occupational hazards in garbage workers.

All of the selected publications sought to identify the occupational hazards to which waste workers are exposed in several Brazilian cities. Others also discussed a variety of diseases resulting from that career, while a few of them also addressed how to minimize or prevent occupational hazards. With that being said, the thematic analysis was based on the following themes: types of occupational hazards in urban waste workers and hazard prevention measures.

## DISCUSSION

### OCCUPATIONAL HAZARD IN WASTE WORKERS

In developing countries, waste management procedures are characterized by a dominance of manual labor tasks, which therefore exposes waste professionals to a number of



**Figure 1.** Flowchart for the review of papers.

**Chart 1.** Results from electronic database and gray literature search displayed in chronological order.

Author/Year of publication	Method	Objective	Results
Database studies			
Nunes et al., 2006 <sup>9</sup>	Cross-sectional study	Investigation of prevalence of enteroparasitosis among waste collectors in Patrocínio, MG.	22 individuals participated. Among the 14 cases of parasite or commensal infections, 78.6% were caused by protozoa, while 21.4% were caused by helminths.
Graudenz, 2009 <sup>10</sup>	Cross-sectional study	Comparison of health aggravation due to contact with solid waste among waste professionals in São Paulo, SP.	185 subjects participated. Prevalence protozoa infection was 55.9%, sinusitis 14.7-37.8%, pneumonia 8.8-22.2%, hepatitis B 20%, and leptospirosis 25.7%.
Lazzari and Reis, 2011 <sup>11</sup>	Cross-sectional study	Identification of biological hazards affecting urban, solid waste professionals in Dourados, MS.	42 workers participated. Occupational hazards identified were: cuts and perforations with glass, syringes, thorns; bite of dogs; and contact with noxious substances. Such risks diminish with orientation to the population about appropriate waste disposal.
Santos, 2016 <sup>12</sup>	Cross-sectional study	Estimation of prevalence, infection degree, and factors associated with helminth infections in urban garbage workers in Parnaíba, PI.	163 participants. Overall prevalence of helminth infection was 35.58% being the main: ascariasis (25.15%), trichuriasis (7.36%), and hookworm (9.82%).
Galdino and Malysz, 2016 <sup>13</sup>	Cross-sectional study	Identification of occupational hazards in waste workers in the municipality of Mamborê, PR.	7 individuals involved. Constant exposure to biological agents and ergonomic issues reported. Personal Protective Equipment (PPE) showed to be effective in preventing occupational hazards.
Gray literature studies			
Oliveira and Santos, 2008 <sup>14</sup>	Discussion paper	Evaluation of occupational health problems affecting solid management professionals in Hidrolândia, GO.	16 workers participated. Dermatitis prevalence was 6%. Posture, spine, and arm problems were identified. Flu, diarrhea, and acute respiratory infections were also diagnosed. Cuts and perforations were present. Issue related to low adherence to PPE were found.
Silva et al., 2009 <sup>15</sup>	Cross-sectional study	Analysis of work conditions in waste collectors of Muzambinho, MG.	Three out of six individuals interviewed do not use PPE. Risks identified through reports were: run over, cuts, and perforations, dog attacks, muscle strains, falling off the truck.
Pedrosa et al., 2010 <sup>16</sup>	Cross-sectional study	Identification of the main occupational hazards to which solid waste collectors are exposed in Boa Vista, RR.	96 participants. Evidence of cutting, slipping, falling, injury, run over, and contamination from infectious agents.
Pinho and Neves, 2010 <sup>17</sup>	Cross-sectional study	Identification of possible risk factors related to the occurrence of occupational accidents in urban waste collectors in Rio de Janeiro, RJ.	36 workers participated. Prevalence of trampling of 16%. Main lesions identified: cuts, skin injuries, falls, and constant exposure to biological agents. Contributing factors to increase accidents: non-compliance with safety norms and procedures, lack of attention, and absence of PPE.

Continue...

**Chart 1.** Continuation.

Author/Year of publication	Method	Objective	Results
Oliveira et al., 2015 <sup>8</sup>	Cross-sectional study	Identification and evaluation of occupational hazards in garbage workers in Sinop, MT.	53 individuals participated. Solid waste workers exposed to physical, chemical, biological, ergonomic, psychosocial, and accident hazards. Non-compliance with safety standards, lack of attention, and absence of PPE are contributing factors to occupational hazards.
Coelho, 2012 <sup>19</sup>	Cross-sectional study	Identification of socioeconomic profile and working conditions, and occupational health with an emphasis on the occurrence of dermatosis in waste professionals in Morrinhos, GO.	97 workers. 42% of the subjects reported having been affected by occupational dermatosis, being the hand the most affected area.
Carvalho et al., 2016 <sup>20</sup>	Cross-sectional study	Identification of the perception of solid waste professionals of Jataí, GO towards occupational hazards to which they are exposed in the workplace.	17 participants. 82.4% suffered some type of accident, among which: trampling; fall, fracture, and press in a truck; perforations and cuts; chemical accidents (batteries, oils, leachate, and other household waste); dog attacks. Non-compliance with the use of PPE was identified.

occupational hazards of variable nature, occurring at every stage of the waste management process<sup>21,22</sup>.

Considering the possible occupational hazards in the workplace, the Brazilian Ministry of Labor designed a standardized set of colors to indicate the main potential risks to which workers are exposed in the various worksites. The colors are as follows: green is used to represent physical hazards, red for chemicals, brown for any biological hazard, yellow for ergonomic (or “human” factors), and blue to represent hazards related to accidents<sup>23</sup>. The psychosocial hazard, which was also evidenced in the literature<sup>18</sup>, used to be associated with the ergonomic hazard; however, it has been considered a new category<sup>24</sup>, without a standardized color representation, therefore why the authors attributed to it the gray color.

From the analysis of the publications, it was observed that waste management workers are exposed to five main occupational hazards, besides psychosocial hazards. Figure 2 shows the percentage of occupational hazards in those workers based on how much evidence was encountered, considering the number of times that hazards were cited in eligible studies.

Thus, the most evidenced hazards experienced by garbage workers were those of biological nature and accidents, respectively. The most common events happening to those professionals in the workplace are presented in Chart 2.

## BIOLOGICAL HAZARD

Biological hazard is the likelihood of exposure to microorganisms with potential to cause harm to the worker’s health. Throughout the studies, it was identified that waste workers are exposed to contamination by viruses, bacteria<sup>10,14,16-18</sup>, fungi<sup>14,19</sup>, and parasites<sup>9,12</sup>; all which can lead to acute or chronic infections, allergic reactions, and toxic reactions<sup>23,25</sup>.

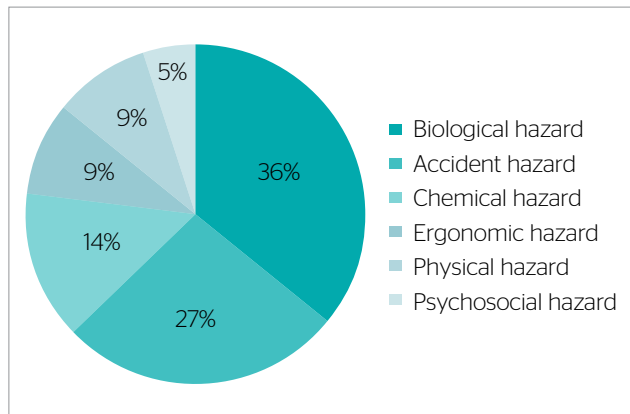
Garbage management workers are susceptible to several biological damages that lead to the acquisition of several infections<sup>16-18</sup>. Sousa et al. (2015), attribute these infections not only to contact with waste, but to sewage and gallery contaminants that contain improperly discarded waste<sup>26</sup>. Contamination with the hepatitis C virus and tetanus bacteria were also mentioned with gastroenteritis appearing more evident in those workers, therefore culminating an increase in diarrheal conditions<sup>12,18</sup>.

In a study carried out in 2006, with a sample of 22 solid waste workers, it was identified the prevalence of 63.66% for parasites or commensals in those individuals, after a laboratorial analysis of feces. Of this percentage, 78.6% corresponded to protozoa while 21.4% to helminths (*Entamoeba coli*, *Entamoeba hartmanni*, *Entamoeba histolytica*, *Endolimax nana*, *Ascaris lumbricoides*, *Trichuris trichiura*, *Strongyloides stercoralis*)<sup>9</sup>. For these studies, it

is important to note the difference between such species. Helminths constitute any disease-causing organisms that live on a human or another animal and derive nourishment from their host<sup>27</sup>, whereas a protozoa is defined as any parasitic single-celled organism that can divide only within a host organism<sup>28</sup>.

Another study also performed similar analysis in 185 workers, identifying the presence of protozoan infection, with sweepers being the most affected (55.9%). In addition, the author identified the incidence of sinusitis in the last twelve months (between 14.7% and 37.8%) and pneumonia (between 8.8% and 22.2%), with waste truck drivers being the most affected. In the evaluation of the positivity for hepatitis B and leptospirosis, it was identified that the sweepers are the most affected (incidence between 20% and 25.7%, respectively)<sup>10</sup>.

In a recent study, Santos (2016) identified the prevalence of soil transmitted helminthiasis above 35% in a sample of 163 workers in Piauí state, northeastern Brazil. The results were obtained from parasitological tests, with a prevalence of 25.15% for ascariasis, 7.36% for trichuriasis, and 9.82% for hookworm<sup>12</sup>.



**Figure 2.** Literature evidence for studies on occupational hazards in waste workers.

**Chart 2.** Classification of the main occupational hazards to which waste workers are exposed according to their nature as evidenced in the literature.

Physical hazard	Chemical hazard	Biological hazard	Ergonomic hazard	Accident hazard	Psychosocial hazard
Excessive noise, vibration, odor, solar radiation, and rainfall <sup>14,18</sup> .	Dusts, gases, vapors, substances, compounds, and chemicals in general <sup>11,18,20</sup> .	Viruses, bacteria, fungi, and parasites <sup>9,10,12-14,16-20</sup> .	Intense and repetitive physical exertion, inadequate posture, and long working hours <sup>13,14,18</sup> .	Cuts and perforation, slips, falls, animal attacks, run-down, press, and amputation <sup>11,14-18,20</sup> .	Devaluation at work, lack of training, and disrespect of society <sup>18</sup> .

Another important aggravation reported in the literature was dermatitis, which can be from fungal origin as well as an immune reaction against antigens. Dermatitis was the complaint of 6% of the 16 individuals assessed in a study of 2008<sup>14</sup>. Yet, in a study with a larger sample of 97 individuals, Coelho (2012) identified a higher prevalence of dermatitis in waste workers (42%), occurring more commonly on the hands<sup>19</sup>. Other diseases often found in those professionals are brucellosis, dengue fever, yellow fever, rabies, viral hepatitis (A, B, C, D, and E), leishmaniasis, and cysticercosis<sup>29</sup>.

Yet, in the context of biological hazards, although not mentioned in the studies found, prions also constitute infectious agents of relevance in waste management. Those protein-composed agents are found to be the cause of occupational diseases in some studies<sup>30</sup>.

## ACCIDENT HAZARD

The risk of accidents - understood as any probability of exposure to a factor that places the worker in a vulnerable situation, affecting their physical integrity and well-being - seems to be a cause of great concern in such professionals<sup>23</sup>. An accident is defined as a sudden and unexpected event that can cause damage not only to the worker, but also to the property or work environment<sup>31</sup>.

In solid waste workers, accident hazards originate from a variety of causes. The literature points out that those workers are exposed to injuries from sharp objects such as glasses, syringes, nails, spikes, and thorns<sup>11,14</sup>. Some authors<sup>15,18,20</sup> also evidence the risk of slips and falls.

Authors also concluded that waste collectors are exposed to the risk of being run over, which according to Pedrosa (2010) is mentioned by 16% of the 96 individuals interviewed in his survey<sup>16</sup>. Other hazards include animal attacks, especially dog attack<sup>15</sup>, press, and amputations through equipment used at work<sup>20</sup>.

## CHEMICAL, ERGONOMIC, AND PSYCHOSOCIAL HAZARDS

Professionals involved in waste management are also susceptible to chemical hazards, when there is a likelihood of contact with chemical agents, including substances, compounds, or products capable of penetrating the body through the respiratory tract, skin contact, or ingestion<sup>32</sup>. In this regard, workers are exposed to manure, smoke, and other toxic substances that are erroneously discarded in the trash, such as pesticides, oils, and batteries<sup>11,20,26</sup>.

Ergonomic hazard is another occupational health risk affecting solid waste workers, which consists in the probability of a treat to the musculoskeletal system due to different factors, such as inadequate posture, excessive weight, excessive or repetitive physical exertion, among others<sup>23,33</sup>. The literature has shown that those individuals have suffered from postural, spinal, and muscle strain problems as a result of the weight they have to carry, as well as the repetitiveness and effort required to perform the functions at work throughout a long shift<sup>13,18</sup>.

In relation to the physical hazard, being the possibility of damage due to exposure to the different forms of energy, it was verified that waste management professionals suffer strong exposure to solar radiation, with intense heat or cold alongside exposure to climatic changes. In addition, they are subject to noise and intense vibrations caused by work equipment, therefore leading to hearing loss<sup>14,18,26</sup>.

Finally, one of the least explored hazards in occupational health<sup>24</sup>, psychosocial hazard has been evidenced in recently published literature<sup>26</sup>. From the literature analyzed, the authors were able to identify that waste workers continue to suffer from a historical discrimination, with the devaluation of their work by society, government, and employees, along with precarious working conditions, and an overall lack of training<sup>18,26</sup>.

## PREVENTION OF OCCUPATIONAL HAZARDS IN SOLID WASTE WORKERS

In a context where there are several occupational hazards affecting solid waste professionals with different etiologies, the use of Personal Protective Equipment (PPE) has been the most effective in contributing to the minimization or elimination of exposure. However, it is a fact of negligence on the part of workers or even employers towards the use and mandatory compliance of PPE, respectively<sup>15,17,18</sup>. In addition, it is of the utmost importance that there be ongoing

guidance programs for workers on the correct use of PPE and handling of urban waste<sup>20</sup>.

Orientation to the population towards the proper disposal of domestic waste seems to be another factor contributing to minimization of occupational hazards in garbage workers<sup>11</sup>. In this way, by combining these actions, the occupational risks can be reduced<sup>26</sup>.

## LIMITATIONS OF THE STUDY

This study has some limitations derived from the fact that there are few national or international publications on occupational hazards affecting Brazilian solid waste workers available on electronic databases. For this reason, the authors included gray literature studies (undergraduate or master's degree paper), none of which negatively affect the quality of this review, based on validation by at least two individuals holding a Master's degree.

Another limitation refers to the generality of the results, which may be compromised since they represent only Brazilian data and are certainly consequences of policy and culture specific to the country. Nevertheless, considering the fact that most developing countries use the same procedures for waste management, mostly involving manual labor, the conclusions obtained through this study can be similar to the ones from future studies conducted in other developing countries.

## CONCLUSION

From the analysis of the literature, it was possible to identify that solid waste workers are exposed to the five main occupational hazards. According to their nature, they are classified as follows: biological, accidental, chemical, ergonomic, and psychosocial hazards. In order to contribute to the minimization and/or elimination of many of these risks, it is necessary to identify the importance of the combination of the guided use of PPE, training to the worker, and orientation to the population on the proper disposal of trash.

There are still few studies on occupational hazard in solid waste workers, which probably reflects the historical and social stereotyping faced by those professionals. Thus, the authors should emphasize the need for more evidence-based research that could serve as a subsidy for the development and implementation of public policies that are favorable to the reduction of occupational risks in the group studied.

## REFERENCES

- World Bank. What a waste: a global review of solid waste management [Internet]. Washington: WB, 2016 [cited Dec 11, 2016]. Available from: <https://openknowledge.worldbank.org/handle/10986/17388>
- Brazilian Institute of Geography and Statistics. Census 2010 [Internet]. Brasília: IBGE, 2015 [cited Dec 13, 2016]. Available from: <http://www.censo2010.ibge.gov.br/>
- Brazilian Association of Public Hygiene and Special Waste Companies. 2015 Overview [Internet]. São Paulo: IBGE; 2015 [cited Jan 10, 2017]. Available from: [http://www.abrelpe.org.br/panorama\\_apresentacao.cfm](http://www.abrelpe.org.br/panorama_apresentacao.cfm)
- Gomes CC, Oliveira RS. Public cleaning agents: a study on the relationship pleasure / pain in the workplace. *Psicol Ciênc Prof.* 2013;33:138-53.
- Vasconcelos RC, Lima FPA, Camarotto JA, Abreu ACMS, Coutinho Filho AOS. Aspects of the complexity of domestic waste collection: management of street work variability. *Gest Prod.* 2008;15:407-19.
- Ravindra K, Kaur K, Mor S. Occupational exposure to the municipal solid waste workers in Chandigarh, India. *Waste Manag Res.* 2016;34:1192-95.
- Leal NSB, Soares MFS, Rocha IT, Ribeiro CG. The attitude of academics in relation to urban cleaning workers. *Psicol Ciênc Prof.* 2013;33:946-63.
- Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med.* 2009;6:e1000097.
- Nunes ALBP, Cunha AMO, Marçal Junior O. Garbage collectors and intestinal parasitosis: the role played by social representations in its prevention. *Ciênc Educ.* 2006;12:25-38.
- Graudenz GS. Infectious and inflammatory indicators among urban waste workers in São Paulo. *Rev Bras Saúde Ocup.* 2009;34:106-14.
- Lazzari MA, Reis CB. Urban garbage collectors in the municipality of Dourados (MS) and their perception towards biological hazards in their work process. *Ciênc Saúde Coletiva.* 2011;16:3437-42.
- Santos CAN. Geohelminthiasis in public waste workers in the city of Parnaíba-Piauí: prevalence and risk factors [Master's thesis]. Rio de Janeiro: Escola Nacional de Saúde Pública Sergio Arouca; 2016.
- Galdino SJ, Malysz ST. Occupational hazards in urban, solid waste collectors. *Rev Percurso.* 2016;8:187-205.
- Oliveira GA, Santos HI. Occupational health evaluation in garbage workers from Hidrolândia, Goiás [Undergraduate study completion paper]. Goiânia: Universidade Católica de Goiás; 2008.
- Silva CC, Silva DC, Charrone G, Lopes JD, Souza PR. Domiciliary waste collection in Muzambinho: analysis of occupational health [Undergraduate study completion paper]. Muzambinho: Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas; 2009.
- Pedrosa FP, Gomes AA, Mafra AS, Albuquerque EZR, Pelentir MGSA. Occupational health in solid waste professionals of Boa Vista, RR. *Annals ENEGEP.* Boa Vista: Federal Council of Engineering and Agronomy; 2010.
- Pinho LM, Neves EB. Accidents at work in a company of urban waste collection. *Cad Saúde Colet.* 2010;18:243-51.
- Oliveira APS, Zandonadi FB, Castro JM. Evaluation of occupational risks among workers from the household solid waste collection in the city of Sinop-MT. *University of Cuiabá.* 2015;1(1):1-26.
- Coelho MM. Working conditions and occupational health of urban waste workers [Master's thesis]. Goiânia: Pontifícia Universidade Católica de Goiás; 2012.
- Carvalho VF, Silva MD, Silva LMS, Borges CJ, Silva LA, Robazzi MLCC. Occupational risks and work accidents: perceptions of garbage collectors. *Rev Enfer UFPE On Line.* 2016;10(4):1185-93.
- Bleck D, Wettberg W. Waste collection in developing countries: tackling occupational safety and health hazards at their source. *Waste Manag.* 2012;32(11):2009-17.
- Jerie S. Occupational risks associated with solid waste management in the informal sector of Gweru, Zimbabwe. *J Environ Public Health.* 2016;2016:1-14.
- Brazil. Brazilian Ministry of Labor. Regulatory standards [Internet]. Brasília: MT, 2015 [cited Dec 13, 2016]. Available from: <http://trabalho.gov.br/seguranca-e-saude-no-trabalho/normatizacao/normas-regulamentadoras>
- Reis P. The eSocial and biomechanical and organizational ergonomic risks, including psychosocial risks. Does it have to be this way? [Internet]. Unidade: ASIST, 2015 [cited Nov 30, 2016]. Available from: <http://www.sis.com.br/postagem.cfm?post=o-esocial-e-os-riscos-ergonomicos-biomecanicos-e-organizacionais-incluindo-os-psicossociais-precisa-ser-assis>
- Jorge Duprat Figueiredo Foundation of Medicine and Occupational Health. Biological hazards [Internet]. National Technical Center/ SP. Brasília: FUNDACENTRO, 2015 [cited Nov 29, 2016]. Available from: <http://www.fundacentro.gov.br>
- Sousa MNA, Pereira AKL, Lira MS, Pinto KHS, Andrade M. Occupational hazards in urban waste workers. *Rev COOPEX.* 2015;6(1):1-11.
- MedicineNet. Medical Definition of Helminth [Internet]. San Clemente: MN, 2016 [cited Nov 29, 2016]. Available from: <http://www.medicinenet.com/script/main/art.asp?articlekey=12321>
- MedicineNet. Medical definition of protozoa [Internet]. San Clemente: MN, 2016 [cited Nov 29, 2016]. Available from: <http://www.medicinenet.com/script/main/art.asp?articlekey=5091>
- Grijó JC, Nunes N. Biological hazards and occupational diseases in urban waste workers [Specialization thesis]. Coronel Fabriciano: Centro Universitário do Leste de Minas Gerais; 2014.
- Pustiglione M, Torres RAT, Sá EC. Doenças causadas por prions and probable occupational nexus. *Rev Bras Med Trab.* 2014;12(2):96-9.
- Brazil. Brazilian Ministry of Labor. Legislation: Regulatory standard 32 [Internet]. Brasília: MT, 2015 [cited Dec 13, 2016]. Available from: <http://trabalho.gov.br/images/Documentos/SST/NR/NR32.pdf>
- Brazil. Brazilian Ministry of Labor. Regulatory standard 9 [Internet]. Brasília: MT, 2015 [cited Dec 13, 2016]. Available from: <http://trabalho.gov.br/images/Documentos/SST/NR/NR09/NR-09-2016.pdf>
- Brazil. Brazilian Ministry of Labor. Regulatory standard 17: Ergonomics [Internet]. Brasília: MT, 2015 [cited Dec 13, 2016]. Available from: <http://trabalho.gov.br/images/Documentos/SST/NR/NR17.pdf>

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