Independent magnitude of occupational risks in the occurrence of work accidents in Brazil: a population-based study

ABSTRACT

Objective: Investigate the independent relationship of multiple exposures to work characteristics and occupational risks factors in the occurrence of accidents at work and on the way to work.

Methods: A cross-sectional study from 47,629 participants of the Brazilian National Health Survey. The association magnitudes were estimated by Odds Ratio and its respective 95% confidence interval.

Results: Exposure to intense noise, biological materials, work experience of 40 years or more and intense physical exertion were independently associated with accidents at work. Only exposure to intense noise and activity with effort 6 to 7 times per week remained independently associated with accidents on the way to work.

Conclusion: This research contributed to highlight the effects of multiple exposures at work responsible for the increasing of accidents at work and on the way to work in Brazil.

INTRODUCTION

Accidents at work are considered serious socioeconomic and public health problems[1]. Data from the International Labor Organization (ILO) shows that approximately 2.34 million of people in worldwide die every year from work-related accidents or illnesses. In addition, 374 million nonfatal accidents are estimated per year. The economic costs are also high corresponding with approximately 3.9% of the global Gross Domestic Product (GDP)[2].

The progress of the productive restructuring has been substantially modified the world of work, directly impacting the occurrence of work accidents. These global changes are most acutely identified in developing countries[3]. While in the United States, the work-related mortality is 3.6 per 100.000 workers, in Latin American countries it reaches 9.3 per 100.000 workers. This scenario shows a great burden of morbidity and mortality caused by accidents and occupational diseases[4]. In this way, the investigation of accidents at work becomes a great relevance strategy to promote the health and safety of workers, especially in two aspects: they are preventable, and therefore avoidable; and the underreporting of these events is still high[5].

Brazil occupies the 4th place among the countries that register the highest number of deaths during labor activities, behind only China, United States and Russia. In the period between 2012 to 2018, there were 4.775.659 occupational accidents in the country, corresponding to 1 accident every 49 seconds. In this same period, 17.449 work-related deaths were registered[6]. The social costs of accidents at work in Brazil are also significant. It is estimated that 373.046.342 workdays were lost as a result of social security differences between 2012 and 2018. This amounts to more than R$ 79 billion in terms of social security expenditures in this period[6].

The Brazilian legislation considers as accidents at work those suffered in the workplace and also events occurring during the commuting of the worker due to the exercise of work activities, as well as that occurring in the path of Home to work or otherwise[7].

In developing countries, statistics on accidents at work are still very worrying. A study carried out among the countries of Latin America and the Caribbean showed a growth of 20% of these occurrences, rising from 14.75 per 100.000 inhabitants in the year

2000 to 17.68 per 100.000 inhabitants in 2010. During the same period, approximately 960.000 people were death[8].

In addition to deaths, accidents on the way to work can cause physical and psychosocial injury, often leading to the removal of numerous workers. One study pointed out that among the five main causes of injuries and Disability Adjusted Life Years (DALYs) are accidents with motor vehicles, pedestrian injuries and motorcyclists[9].

In Brazil, a survey conducted during the period 1998 to 2008 identified a 3.2% increase in the incidence of road accidents. In this same period, there was still a 10.5% increase in the absolute number of cases[10]. In addition, the introduction of the motorcycle used as a means of transport or even a working tool contributed to the increase of the accidents on the way to work records. A study carried out with this population showed an annual incidence of 10.5% of occupational accidents in the country. Among those who suffered accidents, 28.8% reported having suffered more than one occurrence 12 months prior to the interview[11].

In Brazil, several researches have been developed about work accidents, under different approaches. They range from estimates of social security costs[5], quality of accidents at work register in information systems[12], the contribution of urban violence as causes of accidents at work[13], as well as aspects related to surveillance[1]. However, in our country, there are any population-based studies that relate to the occurrence of accidents at work and accidents on the way to work. Although both events are considered as work accidents, the nature of the occupational hazards that contribute to their occurrences are quite different. Thus, the present study aimed to investigate the independent relationship of multiple exposures to work characteristics and occupational risks factors in the occurrence of accidents at work and on the way to work.

METHODS

Study population

We carried out a cross-sectional analysis using the database of the Brazilian National Health Survey conducted between 2013 and 2014 by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística - IBGE), the Brazilian Health Ministry and Oswaldo Cruz Foundation (Fiocruz). The cluster sampling was stratified into three stages by primary sampling units (PSUs): census tracts or set of sectors formed the PSUs; households were the second stage units, and residents aged 18 years or over defined the third stage units. Register of interviews were obtained in 64,348

households, with 60,202 individuals interviewed (non-response rate of 8.1%)[18,19]. We included in this analysis only participants who reported that they were currently working (n=47,629). The PNS was approved by the National Commission of Ethics in Research for Human Subjects, of the Ministry of Health, under the Opinion no. 328.159, of June 26, 2013[18].

Variable responses

The following question was considered in estimating exposure to"Accidents at Work",: "In the last 12 months, did you get involved in any work accident (without considering traffic accidents)? (No / Yes)". For "Accidents on the way to work" we used the junction of two questions: "In the last 12 months, did you get involved in any traffic accident in which you have suffered personal injury (injuries)?" and "Some of these traffic accidents occurred when you were working, going to or from work? Those who answered the first question negatively were classified as "NO" and those who stated both questions were classified as "YES".

Explanatory variables

The following exposures related to the context of the work were assessed through questions:

(1) *Professional experience in years:* "How many years have you been in the main job?", categorized as: <9, 10-19, 20-29, 30-39,> 40;

(2) *Stress at work*: "Thinking about all of your work, are you involved in activities that lead to nervousness that can affect your health?", No and Yes;

(3) *Loud noises*: "Thinking about all your work, are you exposed to noise (loud noise) that can affect your health?", No and Yes;

(4) *Prolonged sun exposure*: "Thinking of all your work, are you in long exposure to the sun that can affect your health?", No and Yes;

(5) *Biological materials*: "Thinking of all your work, are you exposed to biological material (blood, needles, secretions) that may affect your health?", No and Yes;

(6) *Industrial dust*: "Thinking of all your work, are you exposed to industrial dust (marble dust) that can affect your health?", No and Yes.

(7) *Radiation*: "Thinking through all your work, you are exposed to radioactive material handling (transportation, Receiving, Storage, working with x-ray) that may affect Your health?", No and Yes;

(8) *Night work*: "In any of your work, do you work at night?" And "How often do you work at night in any of your work? ", Categorized into: daytime, ≤ 1 time per week, ≥ 2 times per week; and

(9) *Intense physical exertion*: "At your job, you do heavy cleaning. carry weight or do other heavy activity that requires intense physical exertion? "and" In a normal week. on how many days do you do these activities at work?", categorized as: none, ≤3 times a week, 4 - 5 times a week, 6 - 7 times a week.

Covariables

Potential confounding factors were analyzed: administrative regions (Southeast, Northeast, Midwest, South and North); sex (male and female); age in years (18 -24, 25 - 34 , 35 - 44 , 45 - 54 , 55 - 64 and≥ 65); self-reported skin color (white, brown, black, asian descendent and Brazilian indigenous); educational attainment (university degree or more, high school, elementary school, incomplete elementary school); and family income in quintile (1st highest, 2nd, 3rd, 4th, 1st lowest).

Statistical analysis

The study population's characteristics were presented by using frequencies and their respective 95% confidence intervals (95% CI). The magnitudes of associations between exposures of interest and response variables were estimated using Odds Ratio (OR) and their respective 95% confidence intervals using logistic regression. We estimated the independent associations between each exposure of the work context and the occurrence of accident at work and also on the way to work with the adjustments: administrative region of Brazil (Model 1); sex, age, self-reported skin color, educational attainment; and income (Model 2). Finally, included in model 2 the mutual adjustment for the explanatory variables of interest that were statistically associated (Model 3). The variables that remained statistically significant ($p < 0.05$) were maintained in the final models.

Statistical analyzes were carried out in the statistical software Stata 15.0 (Stata Corporation, College Station, USA) and in order to consider the complexity of the sample

design, weights were considered by using the set of *svy* commands from the statistical software.

RESULTS

The socio-demographic characteristics of the study population are described in Table 1. The Southeast region had the largest population contingent (43.41%). More than half of the interviewees (51.02%) are males with a higher distribution in the age groups between 25 and 44 years (46.21%). The most prevalent self-reported skin color was white (47.35%) followed by browns (42.02%); approximately 34% of the interviewees have incomplete elementary education and only 14.44% have university degree or more. The most prevalent income was distributed in the third (22.66%) and the first quintile (28.89%) (Table 1).

Table 2 presents the prevalence of accidents at work and accidents on the way to work, as well as the occupational risk exposure profile. About 4.36% suffered accidents at work and 1.66% were victims of accidents on the way to work. Approximately 71% of respondents have less than 9 years of professional experience (Table 2).

Regarding exposures to occupational risk factors, 35.57% reported stress in the work environment; 32.48% presence of noise; 28.31% prolonged exposure to the sun; 9.10% industrial dust; 9.09% radiation exposure, and 4.86% to biological materials. About work shifts, 14.77% reported night work; of these, 11.23% reported a frequency of 2 times or more nights work-shifts per week. Approximately 27% use intense physical effort during their working day, which 17.17% with a frequency of 4 or more times a week (Table 2).

Table 3 shows the associations of exposures to occupational risks with the occurrence of accidents at work and accidents on the way to work. After adjustment for administrative regions, were more likely to suffer from accidents at work those exposed to stress at work (OR: 1.25, 95% CI: 1.01 - 1.54), intense noise (OR: 2.08, 95% IC: 1.66 - 2.61), prolonged exposure to the sun (OR: 2.15; (OR: 1.96, 95% CI: 1.32 - 2.19), industrial dust (OR: 2.29, 95% CI: 1.72 - 3.04), radiation (OR: 1.65, 95% CI: 1.05 - 2.58), which possess 40 or more years of experience (OR: 2.42; 95% IC: 1.24 - 4.87) and who

underwent intense physical exertion (less than 3 times a week: OR 3.33; 95% CI: 2.42 - 4.56; 4 to 5 times a week: OR 3.41, 95% CI: 2.44 - 4.77, and for 6 to 7 times a week: OR 4.32, 95% CI: 3.35 - 5.57) (Table 3).

After adjustment for sex, age, self-reported skin color, educational attainment and income, no significant changes were observed in magnitudes of associations (Model 2). After mutual adjustment for the exposures that remained associated in model 2, only workers exposed to intense noises (OR: 1.62, 95% CI: 1.30 - 2.02), biological material (OR: 2.16, 95% CI 1.40 - 3.34), had 40 or more years of work experience (OR: 3.08, 95% IC: 1.48 - 6.37) and intense physical exertion (OR for ≤3 times per week: 2.64; 95% CI: 1.90-3.68; OR for 4-5 times per week: 2.28; 95% CI: 1.63 - 3.18 and OR for 6 - 7 times a week: 3.02; 95% CI: 2.29 - 3.99) remained associated with accidents at work (Table 3).

Considering accidents on the way to work, after adjustment by administrative region (Model 1), the individuals associated with a higher probability of occurrence of this outcome were exposed to stress at work (OR: 1.26, 95% CI: 1.05 - 1.75), intense noise (OR: 1.72, 95% CI: 1.20 - 2.27), prolonged sun exposure (OR: 1.56; 95% CI: 1.19 - 2.06), industrial dust (OR: 1.86, 95% CI: 1.28 - 2.72), radiation (OR: 2.51, 95% CI: 1.16 - 5.41), and intense physical exertion 6 to7 times per week (OR 2.04; 95% CI: 1.34 - 3.12) (Table 3).

After adjustment for demographic characteristics (Model 2), stress at work and industrial dusts remained not associated with accidents on the way to work and neither radiation exposure which was borderline (p-value = 0.051). After mutual adjustment for multiple factors of the work process (Model 3), those exposed to intense noise (OR: 1.36, 95% CI: 1.02 - 1.81) and intense physical exertion 6 to 7 times a week (OR: 1.65; 95% CI: 1.06 - 2.75) remained significantly associated with the occurrence of accidents on the way to work (Table 3). Night work was not associated in any of the models in the occurrence of accident at work and also on the way to work.

DISCUSSION

In the present population-based study we observed that, in the presence of multiple factors of the work process, those who reported being exposed to intense noise,

biological materials, having work experience of 40 years or more and exercising with intense physical exertion were independently associated with accidents at work. Regarding to accidents on the way to work, only those who reported exposure to intense noise and activity with effort 6 to 7 times per week remained independently associated. According to Global Burden Disease, occupational and environmental risks accounted for more than 9 million deaths in 2017, an increased of 2.2% compared to 2007. Workplace conditions and exposure to occupational risk factors are potentially harmful for the occurrence of serious or fatal events[9]. These data are of great relevance, since they suggest the fragility of the public policies and actions of safety and health of the workers adopted in Brazil.

In this study we observed that exposure to biological materials accounted for 116% (95% CI: 1.40 - 3.34) of the occurrence of occupational accidents, independently of other occupational risks factors. Occupational exposure to blood borne pathogens and other bodily fluids from needle or wound injuries affects approximately 385,000 health professionals per year in the United States[14].

This risk is also present in the general population. A case-control study conducted in Brazil used information from work accident registers from 1989 to 2010 and identified 8,568 events of biological materials accidents and 2.1% involved individuals who presented no presumed risk for this occurrence[15]. This represents a major challenge for the health sector given the general population's lack of knowledge about the adoption of prophylactic behavior after exposure to biological agents, especially HIV and Hepatitis B and C[16]. These numbers are highly underreported and do not represent the true magnitude of this problem in Brazil; the low quality of the records in the information systems represented a great challenge for the planning of actions in workers' health by the Unified Health System.

In our study, the exposure to intense noise presented a statistically significant association for the increase of accidents at work. There is increasing evidence showing that exposure to occupational noise affects negatively the health and safety of workers[17, 18]. The continued exposure to noise can cause various pathologies beyond hearing loss, such as psychiatric symptoms, increased stress, sleep disturbances[19], hypertension[20] and cardiovascular diseases[21]. Further, previous studies suggest that these physiological changes may be related to increased risk of serious and fatal work-related accidents[17, 18,

[22]. In Canada, a research conducted with more than 88.300 workers exposed to occupational noise identified a 10% to 30% increase in the chances of suffering serious work-related accidents[5]. Also, in the United States, a cohort study demonstrated an association between exposure to noise and the risk of occupational accidents[23]. However, the association between noise exposure and increased risk of occupational accidents is not a consensus in the literature. A study enrolled in British Columbia did not prove the association between noise exposure and the occurrence of occupational accident[24]. While this association is not well characterized, it is necessary to pay more attention to the surveillance of occupational noise, besides adopting the best preventive health and safety practices at work. It is also incumbent upon health professionals to investigate in depth the current and previous occupational history of their patients, as well as greater attention to the ototoxic factors present in the work environment. These procedures are fundamental for establishing a causal relationship between exposure to noise and the occurrence the accidents at work.

Regarding to accidents on the way to work, after adjustment for sociodemographic characteristics, exposure to intense noise, prolonged exposure to the sun and intense physical exertion of 6 to 7 times a week were associated with a higher occurrence of this outcome. However, after mutual adjustment for multiple exposures, only exposure to intense noise and activity with intense physical exertion remained independently associated.

The increase of noise pollution in the road networks of the great urban centers of the country may be related to the occurrence of accidents on the way to work. In this way, noise can interfere with the dispersion of drivers' attention and increase the number of accidents. Another important aspect to be discussed is the exposure to ototoxic agents released in the combustion of fossil fuels and their role in decreasing auditory acuity, compromising drivers' responsiveness to sound and alert sound stimuli. In addition, several studies have already shown the association between exposure to noise with increased physical and mental stress. Combined, these risk factors increase the prevalence of road accidents[13, 25, 26].

Intense physical exertion is associated with the occurrence of accidents at work and on the way to work. In Asia, the phenomenon of exhaustive work is an important occupational and public health issue, responsible for the increasing in work

accidents, in addition to the elevated of non-communicable chronic diseases such as strokes and cardiovascular diseases[27].

In Brazil, the use of intense physical effort in the work environment is characterized as painful work. Although our research showed a strong association with the increase in accidents at work and on the way to work, it's important to note that in the country, there are no legal provisions responsible for regulating the work as painful work. What exists are the concepts of dangerousness and insalubrity, which do not meet the complexity of what exhaustive work represents[28]. Without the State legal bases to carry out local inspections and public policies of health and safety at work, situations involving painful work may become more frequent, potentially increasing the occurrence of serious and fatal work accidents.

The highest time of professional experience was related to the occurrence of accidents at work, but did not remain in any models for accidents on the way to work. These results may reveal the fragility of the Brazilian legislation in correctly characterizing the accident on the way to work, reducing its role to strictly pecuniary discussions and disregarding the importance of these elements for the outcome of the event[29].

This study tried to overcome two major obstacles in the field of labor accident surveillance in Brazil: underreporting notification and the lack of more effective health surveillance measures for workers. In this way, it contributed to subsidize the Brazilian Unified Health System (SUS) regarding the planning, organization and execution of actions in the scope of assistance and promotion of workers' health at the national level. In addition, it was possible to present an overview of the main occupational risks involved with the occurrence of accidents at work and accidents on the way to work in Brazil.

CONCLUSION

Work accidents are complex and multi-causal events. However, our research has contributed to highlight the main risk factors responsible for increasing the occurrence of accidents at work and on the way to work in Brazil. This is of great relevance because, although the Brazilian legislation considers the two events as work accidents, both present in their genesis, different causes.

In this way, we hope to contribute to the formulation of more effective public health policies in the field of Occupational Health. It is also necessary to carry out and qualify surveillance actions and health promotion in work environments, acting as strategic devices to reduce the occurrence of work accidents in Brazil.

We also aim to make health professionals aware of the relevance of these problems in the epidemiological, economic and social spheres as a way of reformulating care practices in order to improve the quality of health care for workers. Finally, it is necessary to adopt intersectoral actions, involving the various segments of society that dialogue with the problems of accidents at work. Only with the adoption of all these measures, we are moving towards the change of this epidemiological reality in Brazil and in the world.

1. Ferreira MJM, Lima RKS, Silva A, Bezerra JGF, Cavalcanti LPG. Surveillance of occupational accidents by sentinel workers' health centers in the municipality of Fortaleza, Northeast of Brazil. Cien Saude Colet. 2017;22(10):3393-402.
2. Office IL. Safety and Health at Work. International of Labour Office [Internet]. 2017.
3. Cavalcante CAaA, Enders BC, Menezes RMP, Medeiros SM. Riscos ocupacionais do trabalho em enfermagem: uma anÃ¡lise contextual. CiÃªncia, cuidado e saÃºde. 2006;5(1):088-97.
4. Jin K, Courtney TK. Work-related fatalities in the People's Republic of China. Journal of occupational and environmental hygiene. 2009;6(7):446-53.
5. Santana VS, AraÃºjo-Filho JB, Albuquerque-Oliveira PRr, Barbosa-Branco A. Acidentes de trabalho: custos previdenciÃ¡rios e dias de trabalho perdidos. Revista de saÃºde pÃºblica. 2006;40:1004-12.
6. Brasil MPdTd. Observatório Digital de Saúde e Segurança do Trabalho https://observatoriosst.mpt.mp.br: MInistério Público do Trabalho/Organização Internacional do Trabalho; 2019 [
7. <Notificação dos AT.pdf>.
8. Videnros C, Selander J, Wiebert P, Albin M, Plato N, Borgquist S, et al. Postmenopausal breast cancer and occupational exposure to chemicals. Scandinavian journal of work, environment & health. 2019.
9. Stanaway JD, Afshin A, Gakidou E, Lim SS, Abate D, Abate KH, et al. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet. 2018;392(10159):1923-94.
10. Almeida FS, Morrone LC, Ribeiro KB. [Trends in incidence and mortality due to occupational accidents in Brazil, 1998-2008]. Cad Saude Publica. 2014;30(9):1957-64.

11. Amorim CR, de Araujo EM, de Araujo TM, de Oliveira NF. Occupational accidents among mototaxi drivers. Rev Bras Epidemiol. 2012;15(1):25-37.
12. Galdino A, Santana VS, Ferrite S. Quality of the record of data on fatal workplace injuries in Brazil. Rev Saude Publica. 2017;51:120.
13. Cordeiro R, Luz VG, Hennington ÉA, Martins ACA, Tófoli LF. A violência urbana é a maior causa de acidente de trabalho fatal no Brasil. Revista de Saúde Pública. 2017;51:1-12.
14. Sharps safety for healthcare settings [Internet]. Center of Disease Control and Prevention. 2016 [cited April 11, 2019]. Available from: https://www.cdc.gov/sharpssafety.
15. Salgado TsA, Ream PSF, Teles SAj, Lima LKOL, Rezende FR, Cardoso NQ, et al. Accidents with biologic material in health services among persons with no presumed risk. American journal of infection control. 2016;44(12):1726-8.
16. Diaz JC, Johnson LA. Health care worker follow-up compliance after occupational bloodborne pathogens exposure: A brief report. Am J Infect Control. 2016;44(12):1738-40.
17. Girard SA, Picard M, Davis AC, Simard M, Larocque R, Leroux T, et al. Multiple work-related accidents: tracing the role of hearing status and noise exposure. Occup Environ Med. 2009;66(5):319-24.
18. Estill CF, Rice CH, Morata T, Bhattacharya A. Noise and neurotoxic chemical exposure relationship to workplace traumatic injuries: A review. J Safety Res. 2017;60:35-42.
19. <Effect of acute exposure to loud occupational.pdf>.
20. Willich SN, Wegscheider K, Stallmann M, Keil T. Noise burden and the risk of myocardial infarction. European heart journal. 2005;27(3):276-82.
21. Bortkiewicz A, Gadzicka Eb, Siedlecka J, Szyjkowska A, Viebig P, Wranicz J, et al. Work-related risk factors of myocardial infarction. International journal of occupational medicine and environmental health. 2010;23(3):255-65.
22. Rushton L. The Global Burden of Occupational Disease. Current Environmental Health Reports. 2017;4(3):340-8.
23. Cantley LF, Galusha D, Cullen MR, Dixon-Ernst C, Rabinowitz PM, Neitzel RL. Association between ambient noise exposure, hearing acuity, and risk of acute occupational injury. Scand J Work Environ Health. 2015;41(1):75-83.
24. Kling RN, Demers PA, Alamgir H, Davies HW. Noise exposure and serious injury to active sawmill workers in British Columbia. Occup Environ Med. 2012;69(3):211-6.
25. Castillo-Rosa J, Suarez-Cebador M, Rubio-Romero JC, Aguado JA. A decade of occupational accidents due to direct or indirect electrical contact in the primary, secondary and tertiary sectors in Spain (2003-2012). Int J Inj Contr Saf Promot. 2017;24(1):97-105.
26. Tsukada T, Sakakibara H. Risk assessment of fall-related occupational accidents in the workplace. J Occup Health. 2016;58(6):612-21.
27. M YTYTTMSTMSKKTTT. Overwork-related disorders in Japan: recent trends and development of a national policy to promote preventive measures. Industrial Health. 2017;55:293-302.
28. Silva MSdJEdSdT-F. Análise das impugnações periciais e aspectos relativos às perícias de insalubridade e periculosidade na Justiça do Trabalho. 2017.
29. Cordeiro R. A inadequação da classificação oficial dos acidentes de trabalho no Brasil. Cadernos de Saúde Pública. 2018;34:e00173016.

Table 1: Sociodemographics characteristics of study population, National Health Survey (PNS), Brazil, 2013

Variable (N)	%	95%CI*
Administrative Region (46.644)		
Southwest	43.41	42.60 - 44.23
North	7.50	7.25 - 7.76
Northeast	25.89	25.18 - 26.60
South	15.45	14.92 - 15.97
Midwest	7.72	7.46 - 7.98
Sex (46.644)		
Male	51.02	51.02 - 52.71
Female	48.13	47.28 - 48.97
Age in years (46.282)		
18-24	16.22	15.55 - 16.90
25-34	24.48	23.77 - 25.20
35-44	21.73	21.04 - 22.43
45-54	19.04	18.40 - 19.67

≥55	18.49	17.82 - 19.17
Self-reported skin color (46.643)		
White	47.35	46.42 - 48.27
Brown (*Pardo*)	42.02	41.12 - 42.93
Black	9.26	8.75 - 9.77
Asian Descendent	0.94	0.07 - 0.10
Brazilian indigenous	0.04	0.03 - 0.04
Educational Attainment (46.750)		
University degree e	14.44	13.62 - 15.26
High school	35.38	34.54 - 36.21
Elementary school	15.87	15.25- 16.49
Incomplete elementary school	34.29	33.36 - 35.23
Income in quintil (35.131)		
1st (higher)	18.15	17.25 - 19.04
2nd	19.17	18.37 - 19.97
3rd	22.66	21.80 - 23.52
4th	11.10	10.51 - 11.69
5th (lower)	28.89	27.93 - 29.86

*95%CI = 95% Confidence Interval

Table 2. Prevalence of accidents at work , accidents on the way to work and occupational exposures, National Health Survey – Brazil, 2013

Variable (N)	%	95%IC*
Accident at work (46.644)		
No	95.64	95.30 - 95.97
Yes	4.36	4.02 - 4.70
Accident on the way to work (46.616)		
No	98.33	98.12 - 98.54
Yes	1.66	1.45 - 1.87
Professional experience in years (35.670)		
≤10	71.08	70.18 - 71.98
10-19	15.99	15.28 - 16.70
20-29	8.08	7.56 - 8.60
30-39	3.39	3.01 - 3.77
≥ 40	1.44	1.23 - 1.65
Job stress (35.670)		
No	64.42	63.37 - 65.48
Yes	35.57	34.53 - 36.65
Intense noises (35.670)		
No	67.51	66.56 - 68.46

Yes	32.48	31.53 - 33.43
Prolonged solar radiation (35.670)		
No	71.68	70.76 - 72.59
Yes	28.31	27.40 - 29.23
Biological materials (35.670)		
No	95.13	94.72 - 95.54
Yes	4.86	4.45 - 5.27
Industrial dust (35.670)		
No	90.90	90.33- 91.48
Yes	9.10	8.51- 9.66
Radiation (35.670)		
No	90.90	90.33- 91.48
Yes	9.09	8.52- 9.67
Night work (35.753)		
Daytime work	85.22	84.51 - 85.93
Up to 1 Time per week	3.54	3.19 - 388
2 to 3 times a week	3.78	3.43 - 4.12
> 4 times a week	7.45	6.93 - 7.96
Intense physical exertion (35.670)		
None	73.55	72.56 - 74.53
≤3 times a week	9.26	8.73 - 9.80
4 - 5 times a week	9.81	9.13 - 10.48
6 - 7 times a week	7.36	6.86 - 7.87

*95%CI = 95% Confidence interval

Table 3. Associations of occupational exposures with accidents at work and accidents on the way to work, National Health Survey, Brazil, 2013

	Accident at work			Accident on the way to work		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
	OR (95%CI)	**OR (95%CI)**	**OR (95%CI)**	**OR (95%CI)**	**OR (95%CI)**	**OR (95%CI)**
Job stress	**1.25 (1.01 – 1.54)**	**1.42 (1.15 -1.77)**	-	**1.26 (1.05 – 1.75)**	1.25 (0.95 – 1.64)	-
Intense noises	**2.08 (1.66 – 2.61)**	**1.94 (1.55 – 2.43)**	**1.62 (1.30 – 2.02)**	**1.72 (1.20 – 2.27)**	**1.39 (1.04- 1.86)**	**1.36 (1.02 – 1.81)**
Prolonged solar radiation	**2.15 (1.73 – 2.68)**	**1.64 (1.33 – 2.14)**	-	**1.56 (1.19 – 2.06)**	**1.42 (1.04 – 1.94)**	-
Biological materials	**1.96 (1.32 – 2.19)**	**2.73 (1.80 – 4.14)**	**2.16 (1.40 – 3.34)**	0.85 (0.48 – 1.50)	0.99 (0.55 -1.77)	-
Industrial dust	**2.29 (1.72 – 3.04)**	**1.88 (1.49 – 2.54)**	-	**1.86 (1.28 – 2.72)**	1.41 (0.95 -2.08)	-
Radiation	**1.65 (1.05 – 2.58)**	**1.93 (1.20 -3.08)**	-	**2.51 (1.16 – 5.41)**	2.17 (0.99 – 4.71)	-
Night work						
Daytime work	1.00	1.00	-	1.00	1.00	-
≤ 1 night shift a week	1.30 (0.81 – 2.08)	1.39 (0.86 – 2.26)		1.52 (0.71 - 3.24)	1.29 (0.61 - 2.74)	
≥ 2 night shifts a week	1.08 (0.81 – 1.44)	1.07 (0.80 – 1.44)		1.31 (0.91 – 1.87)	1.12 (0.77 – 1.63)	
Professional experiente (years)						
≤9	1.00	1.00	1.00	1.00	1.00	-
10 - 19	1.14 (0.84 -1.57)	1.27 (0.91 -1.78)	1.17 (0.85 -1.62)	0.90 (0.61 – 1.31)	1.14 (0.76 – 1.70)	
20 - 29	1.03 (0.63 – 1.68)	1.23 (0.75 – 2.00)	1.04 (0.65 – 1.67)	0.64 (0.36 – 1.13)	1.03 (0.54 – 1.94)	
30- 39	0.88 (0.42 – 1.83)	1.00 (0.45 – 2.20)	0.90 (0.42 – 1.96)	0.85 (0.41 – 1.77)	1.76 (0.83 – 3.69)	
≥40	**2.46 (1.24 – 4.87)**	**3.46 (1.69 – 7.10)**	**3.08 (1.48 – 6.37)**	1.06 (0.34 – 2.94)	1.69 (0.87 – 8.30)	
Intense physical exertion						
None	1.00	1.00	1.00	1.00	1.00	1.00
≤3 times a week	**3.33 (2.42 – 4.56)**	**3.92 (2.10 – 4.05)**	**2.64 (1.90 – 3.68)**	0.82 (0.53 – 1.29)	0.82 (0.52 – 1.29)	0.79 (0.50 – 1.25)
4 - 5 times a week	**3.41 (2.44 – 4.77)**	**2.71 (1.92 – 3.82)**	**2.28 (1.63 – 3.18)**	1.16 (0.78 – 1.73)	1.04 (0.69 – 1.56)	0.97 (0.64 – 1.46)
6 - 7 times a week	**4.32(3.35 – 5.57)**	**3.55 (2.72 – 4.63)**	**3.02 (2.29 – 3.99)**	**2.04 (1.34 – 3.12)**	**1.75 (1.11- 2.74)**	**1.65 (1.06- 2.57)**

Model 1: Adjusted for administrative region. **Model 2:** Model 1+ gender, age, self-reported skin color, educational attainment and income. **Model 3:** Model 2 + mutual adjustment for exposures that remained associated. Abbreviations: OR = Odds Ratio, 95% CI = 95% Confidence Interval.