Descriptive analysis of labour accidents occurred in Porto Velho (RO) between 2002 and 2012

Análise descritiva dos acidentes de trabalho ocorridos em Porto Velho (RO) entre 2002 e 2012

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ABSTRACT We conducted a descriptive analysis of the historical series of labour accidents occurred between 2002 and 2012, in Porto Velho (RO), in order to identify if there was increase related to the implementation of works of the Growth Acceleration Program in the municipality. Data from the Ministry of Social Security and the Annual Social Information Report were used. An increase in the labour accidents rates was observed from 2008, when the great works began. Although there is insufficient information to estimate the burden of labour accidents attributable to works, we reinforce the need to take actions for reducing workplace risks in large projects.

KEYWORDS Occupational health. Accidents, occupational. Impacts on health.

RESUMO *Realizou-se análise descritiva da série histórica de acidentes de trabalho ocorridos entre 2002 e 2012, em Porto Velho (RO), a fim de identificar se houve aumento relacionado com a implantação das obras do Programa de Aceleração do Crescimento no município. Foram utilizados dados do Ministério da Previdência Social e da Relação Anual de Informações Sociais. Verificou-se aumento na incidência de acidentes de trabalho em Porto Velho a partir de 2008, quando se iniciaram as grandes obras. Embora não haja informações suficientes para estimar a carga de acidentes atribuíveis às obras, evidencia-se a necessidade de tomar medidas para o controle de riscos em grandes empreendimentos.*

PALAVRAS-CHAVE *Saúde do trabalhador. Acidentes de trabalho. Impactos na saúde.*

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Introduction

Work can be understood as one of the necessary factors for good health. However, in the context of work, there may be factors capable of causing the opposite effect and cause harm to the health or integrity of the worker. Such factors are not limited to physical, chemical, or biological risks existing in the work environment. They also include, per Oksanen *et al.* (2011), the social capital of the working environment, in other words, the social structure, regulatory and interpersonal conviviality.

Of the health grievances related to labour, attention is drawn to labour accidents, recognized events, per Gessner *et al.* (2013), as a public health problem, given the potential to cause deleterious effects to worker health. A series of measures, policies and risk control strategies and protection of workers has been implemented over the years in order to reduce, or even eliminate, the exposure to risk factors capable of causing accidents (LEÃO; CASTRO, 2013).

In addition to the work conditions, another important aspect is the nature of the work, since there are different activities, executed in different conditions, that lead to exposure to different risk factors. That is, the nature of work should be considered as an important factor when talking about work, environment, and health. It is in this sense that Porto (2000) highlights the need to, when conducting risk analysis, overcome the general contents of norms and laws that deal with the subject of worker's health and prevention of accident, since they are not sufficiently capable of cope with the specificities of each sector or activity about the inherent risks of work.

With regards to the nature of work, there are social, political and economic changes that condition the labor supply in certain sectors. In Brazil, one sector that has observed growth in the last decade was that of large infrastructure works, much influenced by the Growth Acceleration Program (PAC), launched by the federal government in 2007, through which investments were made in sectors considered structuring, such as urban and energy planning, for example (BRASIL, 2015A). Porto Velho was one of the capitals that received great investment from the PAC. By November 2015, there were 84 social and urban infrastructure projects, five logistical infrastructure projects and four energy infrastructure projects at some stage of implementation in the municipality. Among the energy infrastructure projects is the construction of two hydroelectric plants that mobilized, during the peak of the works, approximately 20.5 thousand workers in each enterprise (ALVES; THOMAZ JUNIOR, 2012; LEME ENGENHARIA, 2005).

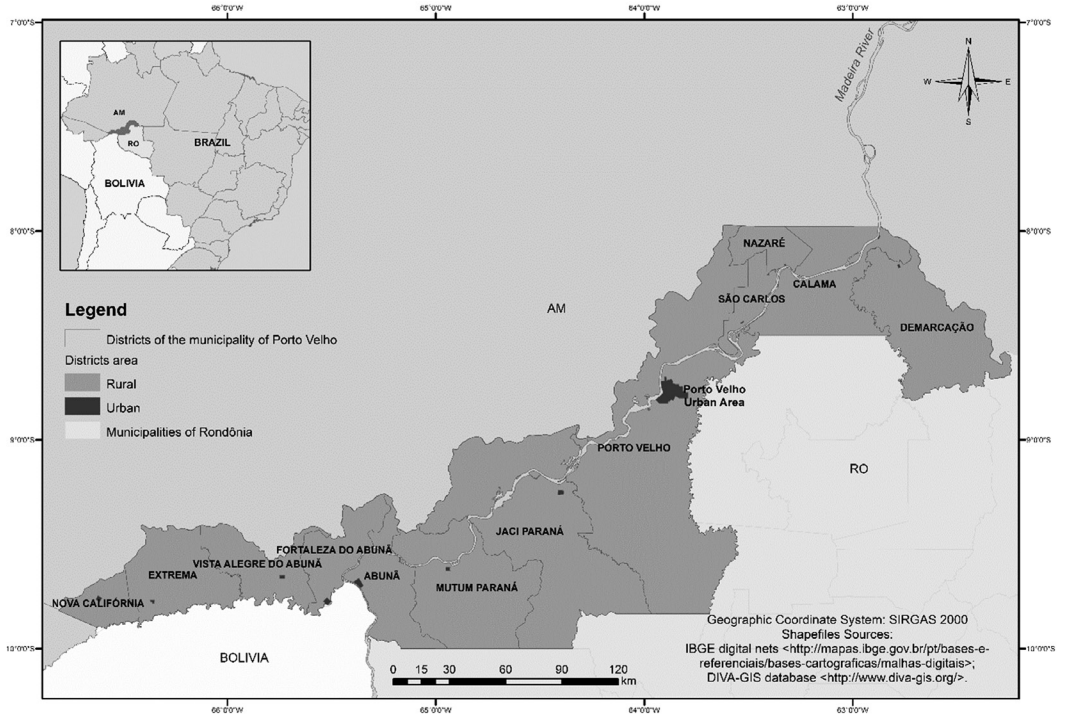
This scenario of development installed in Porto Velho and the changes occurred in the labor market, both regarding the greater job offer and the nature of the work offered, justify analyzing whether there were also changes in the statistics of labour accidents. Once there is a greater number of workers in activity and there is a greater supply of jobs in unhealthy or dangerous conditions, it is possible that more labour accidents are observed, as the works are carried out and that the employment profile and local workforce are changed. Thus, was performed a descriptive analysis of the historical series of labour accidents occurred in the city of Porto Velho, between 2002 and 2012, in order to identify if there was a relation between the increase in the occurrence of labour accidents and the implantation of the great works of the PAC, with the intention of contribute to the discussion about work, environment and health in major infrastructure projects in Brazil.

Material and methods

Porto Velho is the capital of the state of Rondônia, in the northern region of Brazil.

The area of the municipality (*figure 1*), is part of the brazilian Amazon, and through it passes an important water course, the Madeira river. The municipality of Porto Velho was chosen for this study because it is part of the brazilian Amazon – an environmental and economically important area - and due to the contribution of projects originating from the PAC, implemented in the municipality, especially, the hydroelectric plants built on the Madeira river, a river of strategic relevance for Brazil's energy sector due to its hydroeletric potential.

Figure 1. Location of the municipality of Porto Velho (RO) and districts of the municipality



Source: Own elaboration, using shapefiles made available by IBGE (2010) and by DIVA-GIS (s/d).

The descriptive analysis of labour accidents was performed based on the information published by the Ministry of Social Security (MPS) (BRASIL, 2015C) about the labour accidents occurred in Porto Velho, between 2002 and 2012. This database has information about typical accidents and acidentes on the way to work with Work Accident Communication (CAT), deaths due to labour accidents and accidents without CAT. The information available by the MPS covers a large number of occurrences. However, those informations are available already aggregated, and it is not possible to describe details of the occurrences. Therefore, we used the database of the Annual Social Information Report (Rais). The data of Rais were obtained in the page

of microdata of the Rais for the period from 2002 to 2012 (BRASIL, 2012). This basis has the advantage of providing specific information about everyone who have been departed from work for any reason, including labour accidents. Since it only contains information about who have been departed from work, the quantity of cases of labour accidents rescued on this basis tends to be lower than that reported by the MPS, once not every accident, necessarily, results in removal.

In addition, there is a large number of removals in the Rais database that do not contain information about their motives, which tends to reduce even more the number of cases of redeemable labour accidents by this data source. Although this limitation exists, the base was considered in this research to provide information such as sex, age, level of education, salary range, type of work contract and workload, that could hardly be redeemed in another base of unrestricted public access.

As a time frame related to the implementation of the infrastructure works in Porto Velho, the year of 2008 was considered. Although the mobilizations related to the PAC started in 2007, only in 2008 the works started in Porto Velho, such as the construction of the Santo Antônio hydroelectric plant.

The data obtained in the MPS were used to calculate the incidence of labour accidents, applying in the denominator the resident population, aged between 18 and 64 years, moreover, in an attempt to come closer to the contingent of the population of working age. Data about the resident population were obtained for the period from 2002 to 2012, directly on the website of the Department of Informatics of the Unified Health System (Datasus), in demographic and socioeconomic information (DATASUS, 2015).

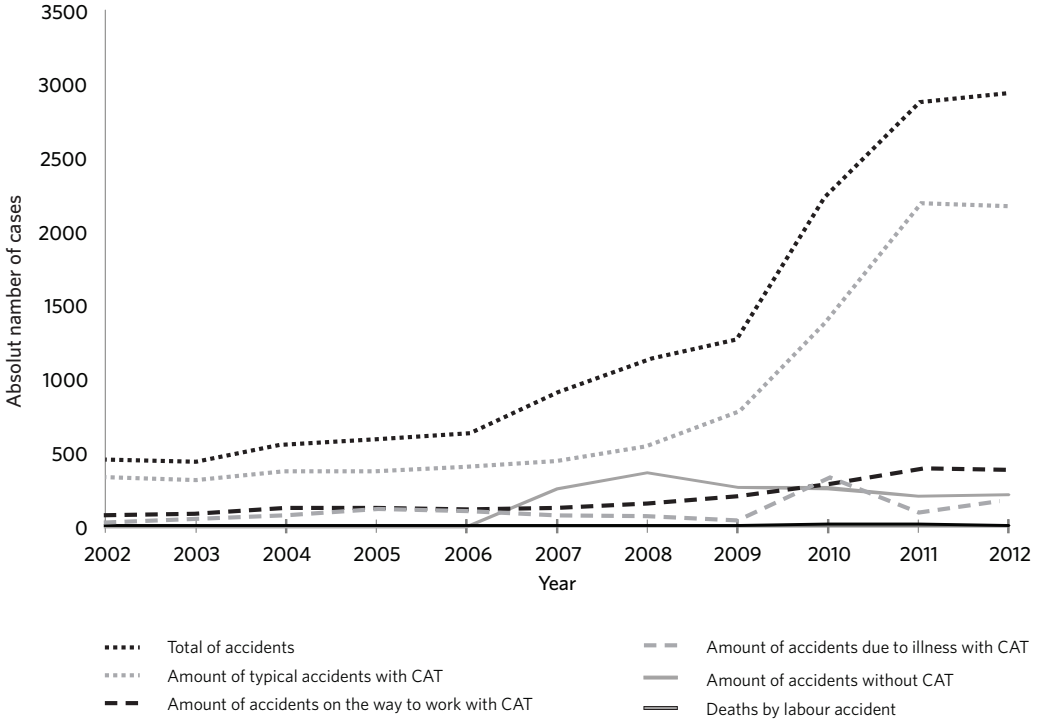
In addition, in an attempt to verify the behavior of the historical series of labour accidents without the supposed effect of the PAC works in Porto Velho, it was estimated, by means of a linear trend function, the number of cases expected for the period between 2008 to 2012. For this purpose, the actual data provided by the MPS for the period between 2002 and 2007 were taken and, based on a linear trend function, the expected cases for the period between 2008 to 2012 were estimated. Thus, it was possible to compare what would be expected in terms of the incidence of labour accidents in the period from 2008 to 2012 with what was really verified in this period.

The graphics and tables presented in this article were elaborated using the software Excel 2013. Also in Excel was made the analysis of linear trend for the period between 2008 and 2012.

Results and discussion

Observing the historical series of the total number of labour accidents occurred in Porto Velho, between 2002 and 2012 (*graph 1*), expressed in absolute number of cases, there is an upward trend, with a relevant increase of, approximately, 130% between 2009 and 2011, ending the series with relative stabilization. However, it is worth noting that since 2007 a survey has been performed based on information about accidental benefits granted by the National Institute of Social Security (INSS), to identify cases of accidents for which CAT was not registered (BRASIL, 2013B), what contributes to the increase in accident cases from that year. The series of accidents without CAT is also represented in *graph 1*.

Graph 1 . Evolution of labour accidents, by typology, and deaths due to accidents occurred in Porto Velho, between 2002 and 2012



Source: Brasil (2015c).

Analyzing only the series of cases of typical accidents with CAT, it's also verified an ascending series, however, smoother than the series of total cases. In this series of typical accidents with CAT, there was a significant increase in the number of cases between 2008 and 2011, of approximately 310%. On the other hand, the series about accidents on the way to work with CAT, accidents due to illness with CAT and deaths by labour accidents showed less expressive magnitude and variation.

Regardless of how much the significant increase in the series of total accidents and typical accidents with CAT can be an effect of improvements of the processes of identification and registration of labour accidents over the years, it is believed that there has been a real, unprovoked increase only by improvements of the procedures for reporting and tracking accident cases. This is said because the Superior Labour Court (TST) moved, in 2012, to Porto Velho, its National Program for the Prevention of Accidents at Work, the Safe Work Program. This program consists of actions and public acts aimed at workers in order to raise awareness about the reduction of the occurrence of labour accidents (TST, 2012).

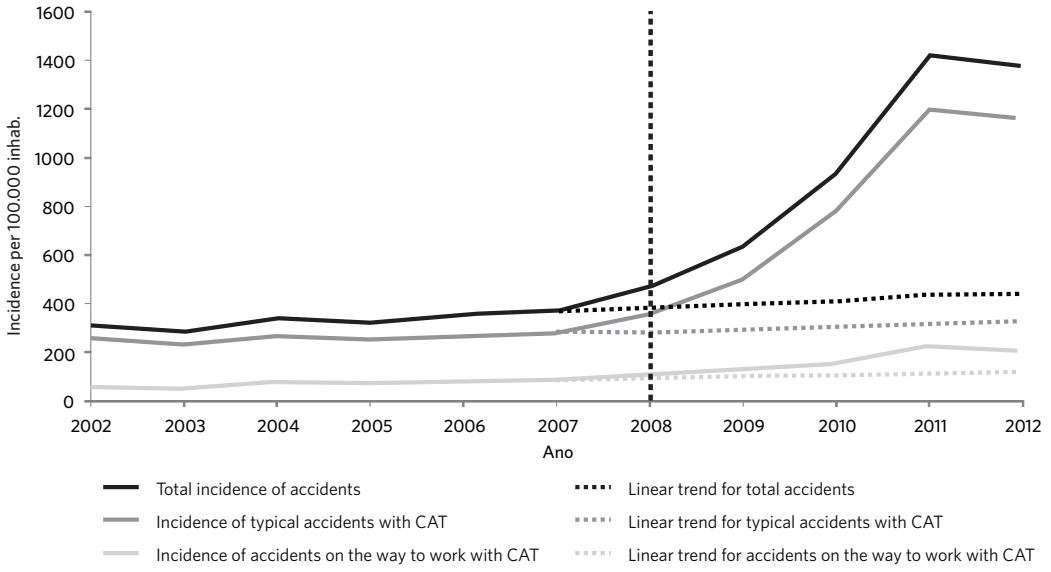
The Safe Work Program is applied in places with high accident statistics and mainly refers to workers in large construction works, due to the amount of labour accidents that occur in this sector. According to the TST:

> the public act has already been performed in major civil construction works and has already passed through Porto Alegre, Recife, Salvador, Brasilia, Belo Horizonte, São Paulo, Natal, Cuiabá, Rio de Janeiro and Fortaleza. The event aims to alert workers about the risks of daily activities, since construction is record holder in the number of deaths in accidents. For every 100 victims at work, at least six are bricklayers, bricklayer's mates or other workers at construction sites. (TST, 2012, P. 1, FREE TRANSLATION).

In Porto Velho, this program reached, mainly, workers in hydroelectric plants, such as, for example, the safe work performed at the Santo Antônio hydroelectric plant (TRT, 2012).

Since the series of absolute numbers of cases may not well represent the impact of accidents on the worker population, the annual incidence of accidents was calculated. In the *graph 2,* the incidence of labour accidents was represented, considering only the cases for which CAT was issued and taking as a population the total residents at the age of 18 to 64 years, as an approximation of the population of working age in the municipality. It was verified that, even in the series of incidents, was significant the increase in the occurrence of typical accidents and, consequently, in the total series of cases since 2008.

Graph 2. The incidence per 100.000 inhabitants*, by typology, of labour accidents in Porto Velho, between 2002 and 2012



Source: Brasil (2015c).

*Population used in the denominator of incidences: resident population aged between 18 and 64 years.

It is observed that both the series of total cases and the series of typical accidents showed a small fluctuation between 2002 and 2007 and an upward trajectory from 2008 to 2011, followed by a fall in 2012. The series of accidents on the way to work also presented an ascending trajectory from 2008 to 2011, however, with small amplitude.

In the *graph 2*, it was also highlighted with a vertical dotted line the year of 2008, that marked the beginning of PAC's works in Porto Velho, such as the Santo Antônio hydroelectric plant and urban infrastructure projects, according to the reports of the PAC Rondônia of 2008 (BRASIL, 2015B). In the *graph 2*, were also represented by dashed lines the linear trends of the series of total cases, typical accidents, and accidents on the way to work. These trends were estimated for the period 2008-2012 based on the data about the period 2002-2007. It was verified that the behavior of the original series, between 2008 and 2012, was very different from what would be expected for the same period, based on the linear trends. This is in agreement with the hypothesis that some factor from 2008 has led to a marked change in the behavior of the series of labour accidents in Porto Velho.

With regard to the PAC works, in addition to those started in 2008, mentioned above, based on PAC Rondônia reports, available on the Program website (BRASIL, 2015B), we have: in 2009, the construction of the Hidroviary Terminal of Porto Velho and of the Jirau Hydroelectric Plant, as well as other urban infrastructure works, such as urbanization and housing and basic sanitation; in 2010, were initiated the works in the BR-364/RO and electrical power transmission works, such as the Madeira-Porto Velho-Araraquara Interconnection Substation (SE Collector Porto Velho); in 2011, in the second phase of the PAC (PAC2), the construction of transmission lines began whose path included Porto Velho, such as the Madeira-Porto Velho-Araraquara Interconnection Transmission Line and the North and Midwest III Interconnection Transmission Line (Rio Branco – Porto Velho); in 2012, were initiated the works of the North and Midwest III Interconnection Transmission Line (Porto Velho-Jauru) and urban infrastructure works, such as housing, sanitation and construction of health units.

The increase in the incidence of typical labour accidents, between 2008 and 2011, may be, in part, related to the realization of these works. The reduction in the incidence of typical accidents, observed in 2012, may be related, in part, to the fact that, in that year, the peak of the works of the hydroelectric plants had already been completed and, at that time, were already initiating the demobilization of large contingent of employees, in addition to some works mentioned previously, such as stretches of power transmission lines and some urban infrastructure works. It is said 'in part' because not all accidents can be attributed to these works, there is a lack of evidence to support this claim, since the data accessed do not inform the contracting company or the working circumstances in which the accident occurred.

In addition, it is possible that other services and activities have been implemented in the municipality to meet the needs of the PAC works or even the contingent of people attracted to them, which is common in the opportunity of installing a large undertaking. This is the case, for example, of small industries and trade activities. Also, these activities may be related to the change in the behavior of the series of accidents at work from 2008 in Porto Velho, although it is expected that the effect of these other undertakings is much smaller compared to the effect of large works due to their nature and the mobilized contingent of workers.

Without entering the merits of issues such as the compliance with the norms of work safety and workers' health, the safe behavior at work or the responsibility for the occurrence of accidents, we return to the

discussion about other factors with potential to increase statistics of accidents at work: more workers in activity and greater supply of jobs in unhealthy or dangerous conditions.

From 2008, the number of jobs in Porto Velho increased considerably. Only the two hydroelectric plants contracted approximately 20.500 workers, each one, in the peak period of the works. These places were filled not only by natural people of the region, but also by many people from other places, who were attracted to Porto Velho.

With regard to the nature of the work, since 2008, works have begun whose nature involves a wide range of hazards, such as, for example, the construction of a port, a hydroelectric plant or an energy transmission line. In any work situation, there may be hazards, and, even if controls are applied, there is the risk of accidents. However, the nature and complexity of work are important issues to be considered when discussing the risks of labour accidents.

In the case of a large economic undertaking, such as a large size hydroelectric plant, there are many risk factors and activities that require strict controls so that accidents do not occur in the construction phase: the height, the water column, the explosions of rock, the movement of heavy materials and equipment, the handling of complex machines and equipment are some examples. The Santo Antônio and Jirau hydroelectric plants, installed in Porto Velho using resources from the Madeira river, were the largest development projects implemented in the municipality through the PAC and that mobilized greater resources, both environmental, financial and human.

The International Energy Agency (IEAHYDRO, 2002) highlights the acute effects of the construction of hydroelectric plants on workers, which includes labour accidents. Lerer and Scudder (1999) mentioned the labour accidents and injuries as possible effects to the health that arise from unhealthy conditions observed during the construction of hydroelectric plants.

There is no secondary database of unrestricted access that contains the information about the cases of labour accidents occurred in the scope of these enterprises, so it is not possible to make a direct and quantitative relation of the effect of the installation of the plants on the statistics of labour accidents in Porto Velho.

However, there are reports of manifestations of employees of these plants demanding better working conditions, such as occurred in March 2011, which resulted in the burning of 54 buses and about 70% of the workers' accommodation in the Jirau plant, where the works came to be suspended (DHESCA BRASIL, 2011). At that opportunity, a report was prepared by the National Rapporteurship for the Human Right to the Environment to investigate allegations of human rights violations in the works of the two hydroelectric plants in Porto Velho. During the monitoring mission for the preparation of this report, it was reported that there were many infraction notices of the Regional Superintendency of Labour for violation of labour legislation (DHESCA BRASIL, 2011). In this report, was also cited a lawsuit filed in July 2010 by the Public Labour Ministry (Case nº 756/2010, filed against the 5th Labour Court of Porto Velho, on July 17, 2010) against the work of the Santo Antônio power plant, alleging a situation of extreme gravity and a marked degree of negligence, being deferred 51 of the 109 injunctions that were requested (DHESCA BRASIL, 2011). Among the recommendations of this report, were presented (DHESCA BRASIL, 2011, PP. 27-29):

> Recommendations of the Rapporteurship for the Human Right to the Environment to the public power regarding violations of human, economic, social, cultural, and environmental rights found: [...] 3. That the BNDES starts conducting field inspections on labour and socio-environmental conditions in large enterprises, in order to suspend the transfer of

> resources to these in case of violation of labour standards and/or mitigating constraints/measures foreseen in the environmental licensing thereof; 4. That the 'Ministry of Labour and Employment' revise the health and safety standards of work in great enterprises to limit the size of the accommodations and the speed of implementation of the enterprises as well as the living conditions in the camps, and also to permit the seizure of these works from a certain level of non-compliance with the legislation. [...] 8. That the 'Public Ministry of Labour' file a civil lawsuit against the noncompliance with health and safety standards in the work of the Jirau hydroelectric plant. (DHESCA BRASIL, 2011, P. 27-29, FREE TRANSLATION).

These actions involve both financier agents of major works and labour-related institutions and their regulation. This reinforces the ideal of interdisciplinarity and co-responsibility when dealing with the occurrence of accidents at work. Attention is also drawn, including, to the role of the Unified Health System (SUS) in relation to workers' health. According to Aguiar and Vasconcellos (2015), the actions of the SUS need to be more effective in order to have an effect on the statistics of labour accidents so that the lack of syntony among the organs responsible for workers' health, which favors the omission by the SUS managers on this issue, be overcome.

There were also found reports by the Workers' League – workers' league in defense of the working class in Brazil – of labour accidents occurred in the construction of the hydroelectric plants in Porto Velho and in the transmission lines. The League reports the death of 44 workers and the disappearance of 11 in the works of the plants and transmission lines in the region (LIGA OPERÁRIA, 2015).

None of these reports is sufficient to make the causal nexus between these undertakings and the behavior of the historical series of annual incidents of typical labour accidents in Porto Velho, but exemplify situations of risk that existed in the scope of these works and that may have led to the occurrence of accidents.

So far, results have been presented and discussed based on data provided by MPS. In addition, Rais data were analyzed in an attempt to find more detailed information about the workers who had removed from the activities due to an accident at work. However, the quality of filling in the Rais data about the cause of removal, according to *table 1*, compromised this analysis. It was already known that not all labour accidents informed by the MPS would be in the Rais, once this last source contains only record of the cases that led to removal, which does not necessarily occur in every accident occasion.

Table 1. Removals reported in Rais, amount of records with no information about the cause of removal and removals due to labour accident. Porto Velho, 2002 to 2012

Year	Removals - n	No information on the cause - n (%)	Removals due to work accident - n (%)
2002	109.096	109.096 (100,0)	-
2003	112.988	110.462 (97,8)	132 (0,12)
2004	129.717	127.109 (98,0)	217 (0,17)
2005	133.420	130.623 (97,9)	257 (0,19)
2006	141.569	138.444 (97,8)	414 (0,29)
2007	151.569	147.238 (97,1)	391 (0,26)
2008	174.135	168.537 (96,8)	482 (0,28)
2009	218.071	211.561 (97,0)	517 (0,24)
2010	271.398	271.398 (100,0)	-
2011	549.972	549.972 (100,0)	-
2012	293.932	281.367 (95,7)	715 (0,24)

Source: Rais (BRASIL, 2012).

In addition, Rais contains individual notifications, whose sum represents the quantity of detached people (in this case, injured). If a person is removed (or is injured) more than once, this will generate a single record with the information of more than one removal. It is possible to inform the Rais, within a single record, the cause of up to three removals. In the MPS, accidents are recorded whose sum expresses, therefore, the total of accidents occurred in the period. Each accident, even if the same person has suffered it, is counted in the sum of accidents reported by the MPS.

Even knowing that in the Rais there would be fewer cases than in the MPS, it was expected, however, that the data from Rais would be better filled. In the Rais database, in 2002, 2010 and 2011, no records had information about the cause of the removal, and, for the remaining years, at least, 95% of the registered removals did not have information about their cause. Despite this limitation, it was possible to describe some characteristics of the accident cases registered in Rais, as shown in *table 2*.

Among the cases of labour accidents reported in the Rais, it was verified that the majority occurred among men, aged up to 39 years, with, at most, complete high school, working between 31 and 44 hours a week and with a monthly income of up to three full minimum wages. There seems to be no significant change in this profile after 2008, although there is no information for 2010 and 2011. Although it is not possible to infer these characteristics to the set of workers of Porto Velho due to the inconsistencies in the Rais database, these data serve as a clue of a possible profile of labour force that suffers most accidents in Porto Velho, or that, at least, gets notified in the Rais.

Table 2. Descriptive analysis of removals by labour accidents reported in Rais. Porto Velho, 2003 to 2012

Variables	Year							
	2003	2004	2005	2006	2007	2008	2009	2012
Workers with at least one removal by typical accident or on the way to work accident reported in Rais (n)	139	233	266	423	398	488	536	730
Gender (%)								
Male	81,29	86,27	80,08	75,89	79,65	79,51	80,78	82,19
Female	18,71	13,73	19,92	24,11	20,35	20,49	19,22	17,81
Age range (%)								
Up to 39 years	68,35	71,24	67,29	65,48	65,08	65,98	66,79	64,79
40 years old or more	31,65	28,76	32,71	34,52	34,92	34,02	33,21	35,21
Education (%)								
Until the complete elementary school	53,96	54,51	55,64	45,86	52,76	47,75	46,45	44,38
High school, although incomplete	37,41	40,77	39,10	47,05	41,96	45,08	47,95	50,41
Higher education, although incomplete or more	8,63	4,72	5,26	7,09	5,28	7,17	5,60	5,21
Range of weekly hours of work (%)								
Up to 30 hours per week	3,60	2,58	2,26	2,84	2,76	2,66	1,87	1,23
From 31 to 44 hours per week	96,40	97,42	97,74	97,16	97,24	97,34	98,13	98,77
Range of remuneration (%)								
Up to 3 full minimum wages	79,14	79,83	81,96	73,52	69,35	74,38	73,51	66,85
More than 3 full minimum wages	20,14	19,74	17,29	12,77	12,31	11,89	14,18	15,75
No information	0,72	0,43	0,75	13,71	18,34	13,73	12,31	17,40
Type of bond (%)								
CLT or statutory with indefinite term	100,00	100,00	98,50	99,05	99,25	99,80	99,44	99,73
CTL or other form of fixed-term contract	0,00	0,00	1,50	0,95	0,75	0,20	0,56	0,27

Fonte: Rais (BRASIL, 2012).

A curious fact is observed about the type of bond. It was expected that there would be more cases of accidents between temporary association, such as: (i) single worker, (ii) regulated by the Consolidation of Labour Laws (CLT) with fixed term or (iii) with a fixed term contract. This is because most of the work contracts in a work tend to have a fixed term.

As shown in *table 2,* this was not verified in the data retrieved in Rais. As hypotheses that can be raised for further investigation on this situation, three will be presented that can be judged as the most plausible. The first is that, in fact, there have been fewer accidents in this group of workers with temporary ties. However, if this group concentrate a larger number of less qualified, younger and lower paid workers, this hypothesis becomes unlikely.

The second is that there may be more difficult for an accident occurring with

a temporary worker to be notified in the Rais, despite all the control so that all the movements and removals are informed by the employers. The Pólis Institute (2006, p. 24, free translation), in covering the case of hydroelectric plants, illustrates this context by reporting that "temporary labour force does not constitute employment relationships (with labour rights) and is extremely fluctuating".

The third possibility is that, although the work is temporary, the bond between the employer (company contracted to execute the work, not the owner of the work) and the operator can have an indeterminate term, which is likely in the case of contractors that assume a work and who, at the end, move their labour to another service, serving to another contract.

When considering the effects on worker health caused by a labour accident as a public health matter, it will be observed the importance of treating such accidents as one of the possible impacts arising from the implementation of economic enterprises. In this case, it would be fundamental that the tools of environmental impact assessment and health impact linked to environmental licensing provide means for labour accidents and worker health to also be arguments for grounding the decision about the viability of the enterprise and to be target of monitoring during all phases of its implementation.

There was an obligation, through the Joint Ordinance MMA/Ibama nº 259, of 2009 (Brasil, 2009), that there was going to be in the Environmental Impact Study/ Environmental Impact Report (EIA/Rima) a specific chapter on the health of workers and that there was in the Basic Environmental Program (PBA) a plan that would help to guide environmental controls during the implementation of the enterprise in the form of a specific program on safety, environment, and worker health. However, this ordinance was repealed in 2013 (Brasil, 2013a), under the allegation that "the environmental licensing procedure already contemplates the evaluation of impacts and reduction of socioenvironmental damages" (Brasil, 2013a, p. 1, free translation). Analyzing the Porto Velho case, it may be that the environmental licensing procedure is not sufficiently capable of dealing with workers' health issues. In this case, the return of the chapter on the worker health would be important, mainly, to reduce the occurrence of labour accidents in large enterprises or in works linked to government programs.

Moreover, the evaluation of health impacts for the licensing of enterprises is not mandatory in Brazil, and its implementation depends on the initiative of the employer or the specific request of a competent body, as happened in the case of the hydroelectric plants in Porto Velho, to which the Brazilian Institute for the Environment and Renewable Natural Resources (Ibama) requested, during the installation licensing phase, a study on the human exposure to mercury. It would be important that assessments of impact on health of great economic enterprises or of government projects address, also, the worker health issues, so that, even before the execution of the works, strategies for monitoring and preventing accidents were defined.

As a limitation of the present study, it is possible to cite the denominator used to calculate the incidence of labour accidents. The question can be raised that these denominators did not include all the workers attracted by the enterprises, especially those with temporary contracts or the residents in housing – as was the case with the Porto Velho hydroelectric plants.

Only for 2010, census year, it was possible to verify whether special sectors, such as employee housing, were included or not in the population count. In the table of identification of the sectors of the 2010 census (IBGE, 2015) (data not shown), there has been no sector classified as housing or workers' camping in Porto Velho,

corroborating the hypothesis that temporary workers or in housing were not included in the count of residents of the municipality that year. The same may have occurred in the other years, since the population estimates in those years take into consideration the population counts in the census years. Therefore, the incidences could be underestimated. However, it is believed that the effect of non-inclusion of those workers on accommodation or with temporary contract has been somehow compensated by the denominator used in the calculation of incidences, since it is unlikely that all residents aged between 18 and 64 would be occupied during the study period.

Conclusion

The increase in the occurrence of labour accidents verified in Porto Velho coincided with the period of implementation of the large works in the municipality, consistent with the initial hypothesis that there would be an increase in the incidence of labour accidents as from 2008. However, there is no sufficient information to make the direct nexus between the surplus of accidents and the implementation of the PAC's enterprises, that is, to estimate the load of accidents attributable to these works.

The verification of this nexus was made difficult by the lack of specific information of each work, since most of the references and data found referred only to hydroelectric plants – considered as the largest and most relevant projects implemented by PAC in Porto Velho – or dealt with the occurrence of accidents without the information on the specific local in which they occurred or on the enterprise in question.

Although there are not enough parameters to define the impact of the works on the occurrence of accidents in Porto Velho, there are subsidies to defend the health impact assessments before its implementation, focusing on the effects on workers, and the realization of assessments during its implementation. Such assessments, as well as environmental impact assessments, could serve as tools for the prevention of accidents and for the improvement of methods of approach, management, identification and reporting of accidents that could accour.

It is understood that labour accidents are an externality whose burden falls on the worker, on society and, often, on the public health system. Therefore, it is necessary to discuss it from the planning stage of the projects or government projects, so that it is avoided or, at least, better internalized by the entrepreneur.

The increase verified in Porto Velho in accident statistics between 2008 and 2012, compared with those from 2002 to 2007, generates the need to take measures to control risks in the work environment and reduce the incidence of accidents. In addition to promote the workers' awareness, such the one performed by the Safe Work program, it is believed to be feasible to return to the chapter on worker health in the EIA/Rima of economic enterprises, as it may be that the environmental licensing procedure is not giving sufficient support for accident prevention and worker health management.

It is hoped that this work may contribute to the discussion about labour accidents as a possible externality of the implementation of economic initiatives, and therefore, their consideration in the study of feasibility and in the monitoring of activities. It is hoped, also, to contribute to the discussion about work, environment and health in the opportunity of the implementation of major infrastructure projects.

Contributors

Carlos Alexandre Rodrigues Pereira contributed substantially to the conception and planning of the article, as well as in

the analysis and interpretation of the data, contributed significantly in the elaboration of the content draft and participated in the approval of the final version of the manuscript. Mirko Severin Winkler and Sandra de Souza Hacon contributed substantially to the design and planning of the article, contributed significantly to the critical review of the content, and participated in the approval of the final version of the manuscript. ■

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