

Impact of the COVID-19 pandemic on the incidence of occupational accidents among beneficiaries of the National Institute of Social Security in Brazil: an interrupted time series study

Impacto da pandemia de COVID-19 na incidência de acidentes do trabalho entre segurados do Regime Geral de Previdência Social no Brasil: estudo de série temporal interrompida

Impacto de la pandemia de COVID-19 en la incidencia de accidentes de trabajo entre los asegurados del Régimen General de Seguridad Social en Brasil: Estudio de series de tiempo interrumpido

Claudio José dos Santos Júnior (<https://orcid.org/0000-0002-2853-1968>)¹

Klauss Kleydmann Sabino Garcia (<https://orcid.org/0000-0003-2268-8742>)²

José Leopoldo Ferreira Antunes (<https://orcid.org/0000-0003-3972-9723>)¹

Frida Marina Fischer (<https://orcid.org/0000-0001-9403-6300>)¹

Abstract *The scope of this study was to analyze the impact of the COVID-19 pandemic on the incidence of occupational accidents among beneficiaries of the National Institute of Social Security in Brazil. It was an interrupted time series study, using data on occupational accidents registered by the National Institute of Social Security from 2015 to 2020. The analysis used the Prais-Winsten generalized linear regression model. The results revealed an immediate reduction ($\beta_1=-0.02$, $p<0.05$) and a change in trend ($\beta_2=-4.46$, $p<0.05$) in the incidence rate of occupational accidents per 10,000 employment links in Brazil and all its macro-regions when the Public Health emergency was declared due to SARS-CoV-2. In the months following the declaration of the Public Health Emergency of National Importance due to COVID-19, the incidence increased ($\beta_3=0.49$, $p<0.05$), approaching the levels observed before the pandemic. The average monthly number of accidents decreased from 11.53 to 9.08 per 10,000 employment links after the declaration of the COVID-19 emergency. These findings indicate that the COVID-19 pandemic has modified the trend and magnitude of the incidence rate of occupational accidents in Brazil.*

Key words Occupational health, Occupational accidents, Interrupted time series analysis, COVID-19

Resumo *Este estudo teve como objetivo analisar o impacto da pandemia de COVID-19 na incidência de acidentes do trabalho entre os beneficiários do Regime Geral de Previdência Social no Brasil. Trata-se de um estudo de séries temporais interrompidas, usando dados sobre acidentes do trabalho registrados pelo Regime Geral de Previdência Social de 2015 a 2020. A análise empregou o modelo de regressão linear generalizada de Prais-Winsten. Os resultados mostraram uma redução imediata ($\beta_1=-0,02$, $p<0,05$) e uma mudança na tendência ($\beta_2=-4,46$, $p<0,05$) na taxa de incidência de acidentes do trabalho por 10 mil vínculos de emprego no Brasil e em todas as suas macrorregiões quando a emergência de saúde pública foi declarada devido ao SARS-CoV-2. Nos meses seguintes à declaração da Emergência de Saúde Pública de Importância Nacional devido à COVID-19, a incidência aumentou ($\beta_3=0,49$, $p<0,05$), aproximando-se dos níveis observados antes da pandemia. A média mensal de acidentes diminuiu de 11,53 para 9,08 por 10 mil vínculos após a declaração da emergência de COVID-19. Esses achados indicam que a pandemia de COVID-19 modificou a tendência e a magnitude da taxa de incidência de acidentes do trabalho no Brasil.*

Palavras-chave Saúde Ocupacional, Acidentes do Trabalho, Análise de Séries Temporais Interrompidas, COVID-19

Resumen *Este estudio tuvo como objetivo analizar el impacto de la pandemia de COVID-19 en la incidencia de accidentes de trabajo entre los beneficiarios del Régimen General de Seguridad Social en Brasil. Se trata de un estudio de serie de tiempo interrumpido, utilizando datos de accidentes de trabajo registrados por el Régimen General de la Seguridad Social de 2015 a 2020. El análisis utilizó el modelo de regresión lineal generalizado de Prais-Winsten. Los resultados mostraron una reducción inmediata ($\beta_1=-0,02$, $p<0,05$) y un cambio de tendencia ($\beta_2=-4,46$, $p<0,05$) en la tasa de incidencia de accidentes de trabajo por cada 10.000 vínculos laborales en Brasil y en todas sus macrorregiones cuando se declaró la emergencia de Salud Pública debido a SARS-CoV-2. En los meses posteriores a la declaratoria de Emergencia de Salud Pública de Importancia Nacional por COVID-19, la incidencia aumentó ($\beta_3=0,49$, $p<0,05$), acercándose a niveles observados antes de la pandemia. El promedio mensual de accidentes disminuyó de 11,53 a 9,08 por cada 10.000 vínculos laborales tras la declaración de la emergencia por COVID-19. Estos hallazgos indican que la pandemia de COVID-19 cambió la tendencia y la magnitud de la tasa de incidencia de accidentes laborales en Brasil.*

Palabras clave Salud Ocupacional, Accidentes de Trabajo, Análisis de Series de Tiempo Interrumpido, COVID-19

¹ Faculdade de Saúde Pública, Universidade de São Paulo (USP). Av. Dr. Arnaldo 715, Cerqueira César. 01246-904 São Paulo SP Brasil.

claudiojunior@usp.br

² Coordenação-Geral de Vigilância em Saúde do Trabalhador (CGSAT), Ministério da Saúde. Brasília DF Brasil.

Introduction

The declaration of the coronavirus disease 2019 (COVID-19) as a pandemic in early 2020 led many governments around the world, including Brazil, to implement various measures to contain the spread of SARS-CoV-2. Several actions were taken, such as the cancellation of large events, closure of childcare centers and schools, temporary shutdown of businesses, trade restrictions, and imposition of travel restrictions, among others¹.

With the implementation of measures to contain the virus spread, many organizations had to temporarily halt their activities, resulting in a decline in the number of available jobs^{2,3}. Moreover, many workers had to adopt remote work as a preventive measure, which brought significant challenges to their routines and work dynamics⁴.

After more than three years since its beginning, the World Health Organization declared the end of the pandemic on May 5, 2023⁵. This means that the organization no longer considers the novel coronavirus a global epidemic. In Brazil, the Ministry of Health declared the end of the Public Health Emergency of National Importance (ESPIN) related to COVID-19 through Ordinance No. 913, which came into effect on May 22, 2022⁶. However, despite the end of the public health emergency, the effects of the pandemic will be felt for a long time, and it is important to understand how it has affected various aspects of life, including the economy, employment, and occupational health.

In several countries around the world, the COVID-19 pandemic has resulted in a reduction in economic activity, leading to a decrease in commercial and industrial operations, and consequently, a reduction in workers' exposure to workplace risks. This has led to a temporary decrease in the incidence of workplace accidents⁷⁻¹⁰. Although the effects of the health crisis on human health have been extensively studied in Brazil, few researchers have examined its impact on workplace accidents, and initiatives aiming to quantify the effect of the COVID-19 pandemic on this phenomenon at a national level remain scarce.

In this context, aiming to contribute to the discussion on the impact of COVID-19 on workers' health, our objective in this study was to analyze the impact of the COVID-19 pandemic on the incidence of workplace accidents among beneficiaries of the General Social Security System in Brazil through segmented regression analysis.

Method

Study design

This study utilized an interrupted time series (ITS) design to analyze the incidence rates of workplace accidents in Brazil and its macroregions from 2015 to 2020. ITS analysis is recognized in the literature as the most effective non-experimental approach for evaluating the longitudinal effects of interventions and testing hypotheses about factors that modify the temporal behavior of health-related measures^{11,12}.

Context

This study focused on Brazil as a whole and its five distinct geographical regions: North, Northeast, South, Southeast, and Midwest. The country comprises 27 federal units, and in 2020, the final year of this research, the economically active and employed population was estimated at around 87.2 million people¹³. Furthermore, the country had approximately 65.6 million active contributors registered in the General Social Security System¹⁴.

Participants

All workplace accidents registered by the National Institute of Social Security, with or without a Workplace Accident Report (CAT), were included in the analysis.

Variables

The data were tabulated for the country and by macroregion (North, Northeast, Southeast, South, and Midwest), and the monthly incidence rates of workplace accidents were calculated using the formula: Incidence Rate = (number of workplace accidents per territorial unit / average annual number of employment links in the territorial unit) x 10,000.

The dependent variable was the monthly incidence rate of workplace accidents, and the independent variables included time (months), level change, trend change, and sine and cosine functions, as recommended. The sine and cosine functions were used to model the seasonal variation of the phenomenon.

The time series of the indicator were divided into two segments: the period before and after the declaration of the Public Health Emergency of National Importance (ESPIN) due to human infection by SARS-CoV-2 in Brazil. This divi-

sion aimed to quantify both immediate changes (level change) and trend changes (slope change). The “post-intervention” period began in March 2020, the month following the confirmation of the first case of COVID-19 in the country and the recognition of ESPIN by the Brazilian government. Thus, the first and second segments were defined as the 62 months prior to the COVID-19 pandemic (January 2015 to February 2020) and the following 10 months after the declaration of the public health emergency (March 2020 to December 2020), respectively.

Data sources and measurement

Monthly data on workplace accidents were collected from the information systems of the Brazilian Ministry of Social Security for the period from 2015 to 2020. The data was obtained from the historical database of the Statistical Yearbook of Workplace accidents (AEAT InfoLogo, <http://www3.dataprev.gov.br/aeat/inicio.htm>), categorized by major Brazilian regions, reasons/situations, consequences, and age groups. The average number of employment links for each year, categorized by regions, was collected from the historical database of the Social Security Statistical Yearbook (AEPS InfoLogo, <http://www3.dataprev.gov.br/infologo/inicio.htm>). These systems were developed by the Technology and Information Company of the Social Security. They serve as the main instruments for presenting data on workplace accidents and employment links related to insured individuals under the General Social Security System at the national level. The database was extracted in May 2023.

Bias

The indicator was stratified by macroregion to homogenize the groups in terms of exposures and identify trends and magnitudes of the phenomenon of interest in the administrative regions of Brazil.

Study size

The study encompasses a 72-month series (January 2015 to December 2020). Only the first year of the pandemic was included in the study due to data availability from the source at the time of collection. However, the number of observations included in the analysis is in line with the recommendations of the specialized literature for time series studies in epidemiology⁶.

Statistical methods

The generalized linear regression of Prais-Winsten was employed as it is referenced in the specialized literature as an appropriate method for dealing with the serial autocorrelation of a historical data series^{11,12,15}. Additional information on this method can be found in the methodological guidelines suggested by Antunes and Cardoso¹².

The regression equation $Y_i = \beta_0 + \beta_1 \cdot \text{time} + \beta_2 \cdot \text{level} + \beta_3 \cdot \text{trend}$, augmented with sine and cosine trigonometric functions, was used. In this model, β_1 represents the pre-pandemic trend measure, β_2 is the level change, i.e., the immediate impact of the pandemic, and β_3 is the trend change, representing the period after the recognition of the public health emergency by COVID-19¹².

The Durbin-Watson statistic and adjusted R^2 were used to assess the adequacy of the models.

To facilitate the visualization of trends and as recommended¹⁶, standardized ITS graphs were created to represent the incidence of workplace accidents before and after the recognition of the public health emergency.

All statistical analyses were performed using Stata software, version 17.1.

Ethical aspects

As this study used publicly available databases, it was not necessary to submit the project to an Ethics Research Committee.

Results

Prior to the pandemic, the national average incidence rate was 11.53 accidents per 10,000 employment links. The regional averages were as follows: North (10.16), Northeast (7.72), Southeast (12.04), South (14.65), and Midwest (11.53). During the pandemic, the national average dropped to 9.08 accidents per 10,000 employment links. The regional averages during the first year of the COVID-19 emergency were: North (7.83), Northeast (5.75), Southeast (9.63), South (11.54), and Midwest (9.08).

Figure 1 presents the evolution of the monthly incidence rate of workplace accidents (per 10,000 employment links) in Brazil and its macroregions from 2015 to 2020.

The trend measures of the pre-pandemic period (β_1) indicated differences in the behavior of this indicator among regions before the

health crisis, but with a general downward trend in all evaluated areas (Table 1).

The downward trend in the incidence rate of workplace accidents was interrupted after the declaration of the public health emergency, with an immediate impact of the pandemic (β_2) on the incidence rate in Brazil and the five administrative regions shortly after the start of the COVID-19 emergency. The magnitude of this reduction was most pronounced in the South region ($\beta_2=-6.16$; $p<0.05$), followed by the Southeast ($\beta_2=-4.41$; $p<0.05$), Midwest ($\beta_2=-3.76$; $p<0.05$), Northeast ($\beta_2=-3.56$; $p<0.05$), and North ($\beta_2=-3.29$; $p<0.05$) regions (Table 1).

The effect of the pandemic was significant ($\beta_3=0.49$; $p<0.05$) in changing the trend (β_3) of the incidence rate of workplace accidents in the country's regions during the ten months following the recognition of the public health emergency. It indicates that the incidence rate increased, returning to the magnitude observed in the pre-pandemic period. The South region showed the highest increase ($\beta_3=0.62$; $p<0.05$), followed by the Southeast ($\beta_3=0.49$; $p<0.05$), Northeast ($\beta_3=0.44$; $p<0.05$), Midwest ($\beta_3=0.40$; $p<0.05$), and North ($\beta_3=0.35$; $p<0.05$) regions (Figure 2).

Seasonal variations were identified in the incidence rate of workplace accidents in all ana-

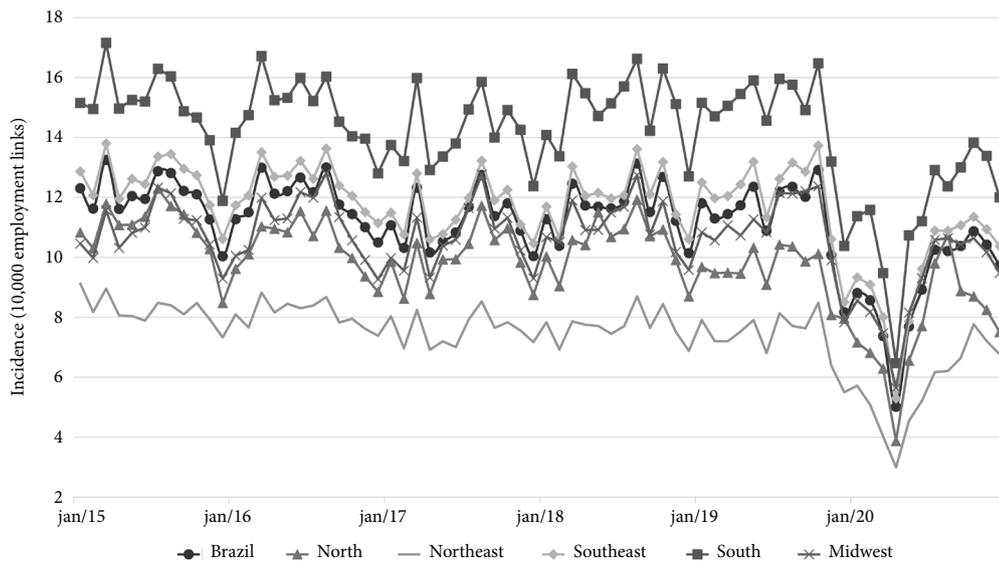


Figure 1. Evolution of the monthly incidence rate of work accidents. Brazil and macroregions, 2015-2020.

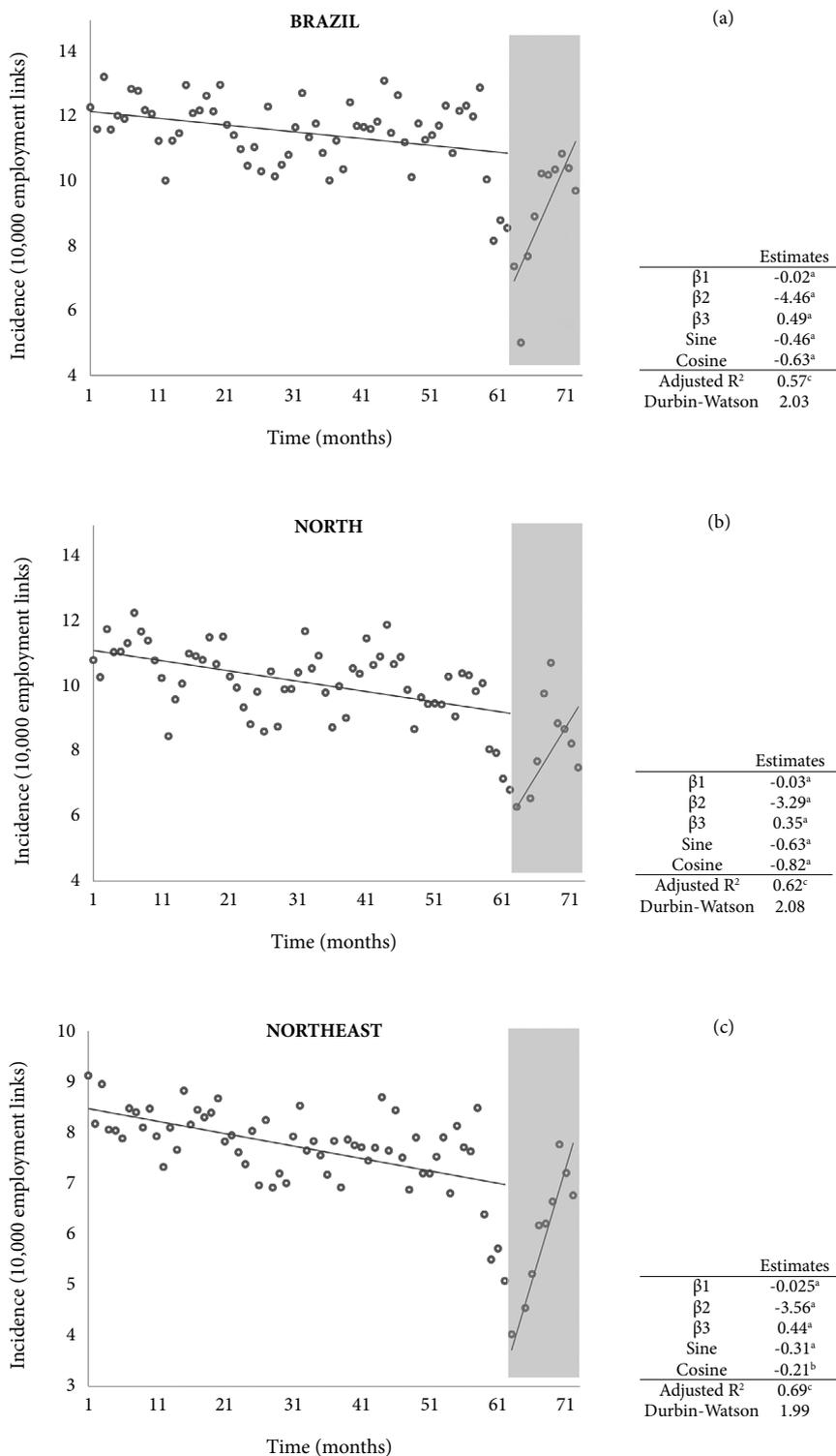
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Table 1. Estimates of the coefficients of segmented regression for the monthly incidence rate of work accidents before and after the onset of the COVID-19 pandemic. Brazil and macroregions, 2015-2020.

Territoriality	β_1	β_2	β_3	Sine	Cosine	Adjusted R ²	Durbin-Watson
Brazil	-0.02 ^a	-4.46 ^a	0.49 ^a	-0.46 ^a	-0.63 ^a	0.57 ^c	2.03
North	-0.03 ^a	-3.29 ^a	0.35 ^a	-0.63 ^a	-0.82 ^a	0.62 ^c	2.08
Northeast	-0.025 ^a	-3.56 ^a	0.44 ^a	-0.31 ^a	-0.21 ^b	0.69 ^c	1.99
Southeast	-0.02 ^a	-4.41 ^a	0.49 ^a	-0.50 ^a	-0.61 ^a	0.53 ^c	2.02
South	-0.01 ^b	-6.16 ^a	0.62 ^a	-0.33 ^b	-0.94 ^a	0.52 ^c	2.00
Midwest	-0.00 ^b	-3.76 ^a	0.40 ^a	-0.66 ^a	-0.85 ^a	0.55 ^c	2.02

^a $p<0.05$; ^b $p\geq 0.05$; ^c $p<0.000$; β_1 : estimator of the pre-pandemic trend; β_2 : estimator of the level change; β_3 : estimator of the trend after pandemic recognition.

Source: Authors.



it continues

Figure 2. Interrupted time series analysis of the monthly incidence rate of work accidents before and after the onset of the COVID-19 pandemic in Brazil (a), in the North region (b), in the Northeast region (c), in the Southeast region (d), in the South region (e), and in the Midwest region (f), 2015-2020.

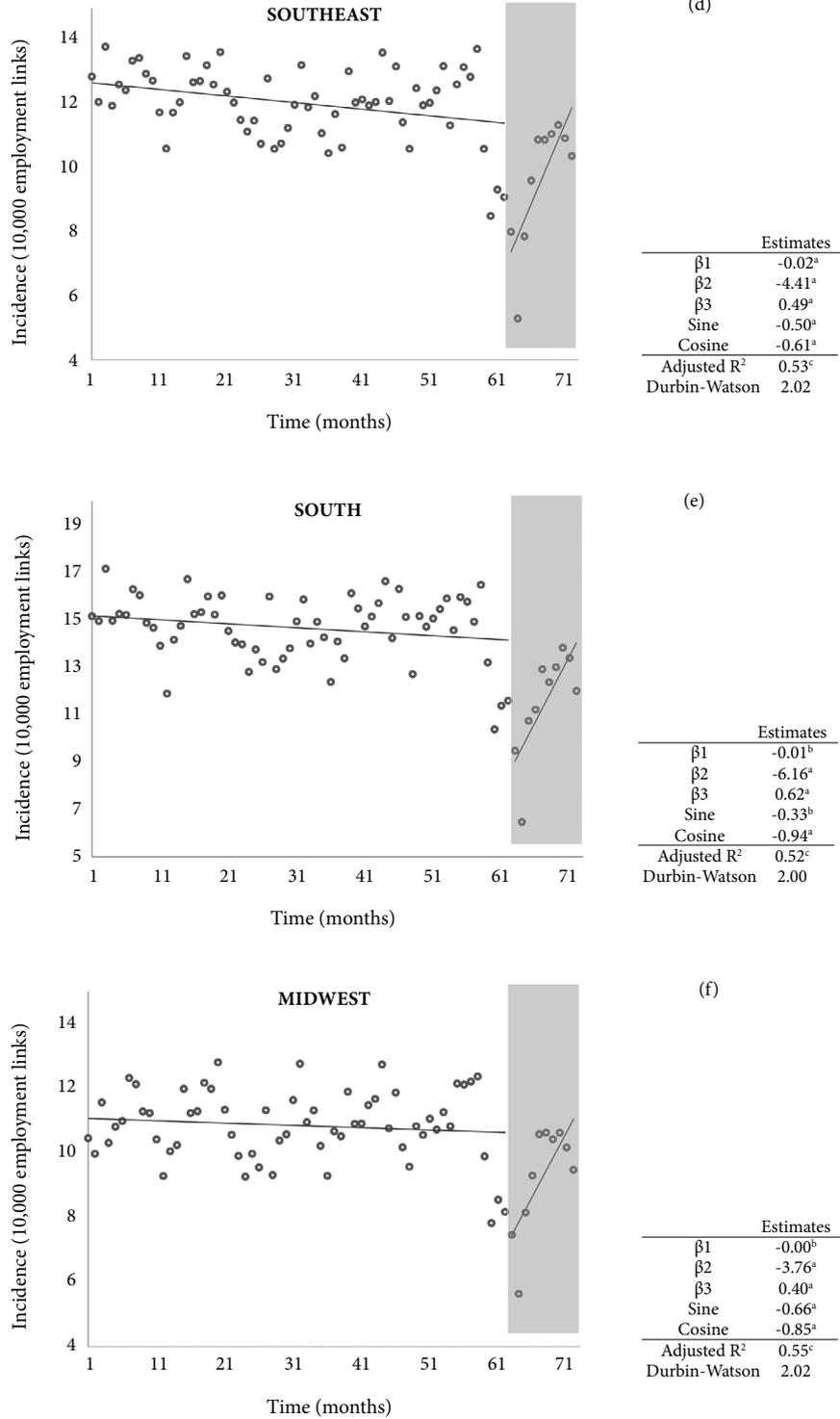


Figure 2. Interrupted time series analysis of the monthly incidence rate of work accidents before and after the onset of the COVID-19 pandemic in Brazil (a), in the North region (b), in the Northeast region (c), in the Southeast region (d), in the South region (e), and in the Midwest region (f), 2015-2020.

^ap<0.05; ^bp≥0.05; ^cp<0.000; β_1 : estimator of the pre-pandemic trend; β_2 : estimator of the level change; β_3 : estimator of the trend after pandemic recognition.

Source: Authors.

lyzed series, as evidenced by the sine and cosine trigonometric functions. Generally, the months of March, June, July, and August had the highest accident rates, while November and December had the lowest values of this indicator.

Figure 2 summarizes the results of the interrupted time series analysis of the monthly incidence rate of workplace accidents before and after the onset of the COVID-19 pandemic in Brazil and by macroregions. It also presents the estimates of regression coefficients and the corresponding p-value for each variable included in the segmented regression model.

The goodness of fit was significant for all models, with R^2 values ≥ 0.52 , $p < 0.000$, and the first-order autocorrelation was controlled in all analyses, with DW values ranging from 1.99 to 2.08.

Discussion

The theme of the different impacts of COVID-19 on the world of work has gained prominence in both national and international studies¹⁷⁻¹⁹. Some publications worldwide have examined the effect of this event on workplace accidents⁷⁻¹⁰, but research in this area has not been identified in Brazil and, until the development of this study, remained scarce.

In 2020, the first year of the COVID-19 pandemic, Brazil stood out as one of the countries most affected by the health crisis in the world, both in terms of SARS-CoV-2 mortality and job losses²⁰. The COVID-19 pandemic had a profound impact on the labor market^{19,21}. The data analyzed here revealed a significant decrease in the incidence rate of workplace accidents in the country during the year 2020 compared to the pre-pandemic period. This decrease was observed shortly after the recognition of the COVID-19 emergency in the national territory and was confirmed by interrupted time series modeling, which identified significant differences in the trend of work accidents after the declaration of a public health emergency due to human infection by SARS-CoV-2 in Brazil.

The nationwide decrease identified in this study coincides with the first social distancing decrees and the closure of non-essential businesses and services, which began to be issued in mid-March 2020 by municipal and state governments as community transmission of the virus intensified^{22,23}. Thus, the immediate reduction in this indicator reflects the impact of the health crisis on the world of work and was influenced by various factors.

Due to the health crisis, there was an unprecedented decline in the employed population and the economically active population^{20,24}, a reduction in economic activity^{2,25}, reduced working hours, layoffs, and contract suspensions (especially in non-essential sectors), changes in work patterns such as the adoption of remote work, flexible hours, team rotation, the adoption of new forms of work such as e-commerce, delivery, and remote learning, as well as the adoption of preventive measures such as social distancing. All of these measures reduced the number of workers present at the workplace, consequently reducing the risks of workplace accidents^{1,4,23,26}.

The gradual increase in the workplace accident rate over the months can be explained by a combination of factors, from the gradual resumption of economic activities to the relaxation of social distancing measures. Over time, activities in different sectors were gradually resumed, resulting in a greater number of active workers and, consequently, an increased risk of accidents. Additionally, social distancing measures and the adoption of safety protocols to prevent the spread of COVID-19 were relaxed over time, which may have contributed to the increase in the incidence of workplace accidents during the first ten months of the public health emergency studied here^{1,27,28}. It is also hypothesized that the exposure to workplace risks may have varied according to the awareness level of workers and employers during different phases of the pandemic, which would also justify the behavior of the indicator. Another factor that may have influenced this change in trend is the possible underreporting of COVID-19 cases at the beginning of the pandemic, which may have led to an initial underestimation of the incidence rate of workplace accidents. Furthermore, it is important to consider that the pandemic overwhelmed various health services, whether public or private, which may have hindered access to medical care and diagnosis for workers who experienced workplace accidents.

In general, the legal definitions of workplace accidents and occupational diseases, as well as the processes of notification and maintenance of administrative records, differ between countries and are often not comparable²⁹. However, a study conducted in Austria also described a decrease in workplace accidents during the pandemic⁷. In Korea, although workplace accidents decreased in some professional sectors, there was an increase in others, such as in the case of men working in the transportation sector⁸. In Turkey, a study also showed a downward trend

in these occurrences in most economic sectors, except for the health and transportation sectors, which experienced an overall increase in accidents during the pandemic⁹. In Italy, the highest number of work compensation claims was recorded during periods coinciding with waves of SARS-CoV-2 in 2020, with healthcare technicians and doctors being the most affected in terms of workplace accidents complaints³⁰.

The presence of seasonal variation in the data, i.e., a trend of increase or decrease in the incidence rate of workplace accidents during certain periods of the year, may be related to the so-called “seasonal factor”^{29,31} and the characteristics of the labor market and environmental conditions in Brazil and its regions³². The analysis of historical series shows that the months of March, July, and August have the highest incidence of workplace accidents, which coincides with the increase in industrial production in the country, as revealed by a study on the seasonality of industrial production in Brazil³³. With increased demand, the workforce and overtime hours may increase, leading to an increase in workplace accidents. At the end of the year, when many companies reduce production, a decrease in the analyzed historical series was observed. These results can help guide public policies and improve workplace accident prevention measures in specific periods and confirm the thesis that workplace accidents occur more frequently at different times of the year³⁴⁻³⁷.

Although the pattern change has affected all regions, it is important to acknowledge that Brazil is a vast and diverse country characterized by significant geographical, cultural, and economic differences among its territories. These distinctions lead to diverse risk scenarios. In predominantly agricultural regions, for example, social distancing measures may have been implemented differently from densely populated urban and industrial areas, influencing the dynamics of the labor market and, consequently, workplace accidents^{23,26}. Other factors, such as lack of information, varying perceptions of the severity of workplace accidents, local political conditions, work organization, ineffective enforcement actions, and a “culture of tolerance” in some places, may have also contributed to the identified differences in workplace accidents reporting to social security³⁸⁻⁴⁰, accentuating regional disparities.

This study has some limitations that should be considered. Firstly, the research was based on secondary data extracted from records that are subject to underreporting and incomplete-

ness, and only include information on workers insured by the General Social Security System. The results exclude civil servants, self-employed individuals, and those outside the General System, who may be exposed to similar or even higher occupational risks than the insured. Self-employed workers, although susceptible to workplace accidents and occupational illnesses, are not considered victims of workplace accidents under social security legislation. Furthermore, informal workers lack registration and access to the benefits of the National Institute of Social Security. Therefore, the results of this study do not fully depict the reality of workplace accidents occurring in the country. Despite this, these data come from official sources and are the same ones that have been used to support social security and welfare public policies in the country. In this regard, it should be noted that, to the best of our knowledge, this work is the first nationwide study to investigate the specific impact of the COVID-19 pandemic on the incidence of workplace accidents in Brazil.

Secondly, the interrupted time series method cannot exclude confounding factors that vary over time and are not part of the underlying trend, such as other interventions or events that may be affecting the evaluated outcome^{11,12,15}. However, this method is considered valuable for measuring the impact of health interventions at the population level and for evaluating factors implemented at clearly defined times that modify the behavior of a variable over time, as was the case with the COVID-19 pandemic. This technique is considered one of the most effective quasi-experimental designs for evaluating the longitudinal effect of factors that modify behavior over time in measures of public health interest¹².

Another limitation is that this study did not analyze the differences in workplace accident trends between economic sectors, occupations, and types of work due to the lack of monthly disaggregated information for these variables in the selected data source. Therefore, it is possible that some occupations or sectors have been more affected than others and may have shown different trends in the incidence of workplace accidents during the health crisis. This limitation highlights the need for future research to provide specific information on how the COVID-19 pandemic has affected the risk of workplace accidents in different economic sectors, occupations, and types of work.

It is also possible that seasonality and peaks in the incidence of workplace accidents may

vary according to the specific characteristics of each sector and economic activity, a factor not explored in this research. For example, in the agricultural sector, peaks in incidence may occur during harvest season when there is a higher demand for labor and more adverse environmental conditions. In the construction sector, there may be an increase in the incidence of workplace accidents during the rainy season, which can increase the risk of accidents. Additionally, during holiday periods such as Christmas and New Year, there may be an increased risk of workplace accidents in the commerce and services sector due to increased customer flow and the resulting service demand. These aspects were not evaluated in this study. Thus, future research is encouraged to provide additional information on the seasonal behavior of workplace accidents in different groups of workers and sectors of the economy, as well as studies that investigate how the COVID-19 pandemic has affected the risk of workplace accidents in different forms of work organization.

Conclusion

This study demonstrated that the COVID-19 pandemic had a significant impact on the monthly incidence rate of workplace accidents in Brazil and its macroregions. An immediate reduction in the incidence rate of workplace accidents was observed in the country and its five regions when the State of Public Health Emergency of National Importance was declared due to SARS-CoV-2. In the following months, the incidence began to increase, approaching the levels observed in the pre-pandemic period.

The findings of this study contribute to the understanding of the effects of the COVID-19 health emergency on the magnitude and trend of workplace accidents. This can guide governmental decisions in the areas of occupational health and safety and support prevention and adaptation measures to address future health emergencies and crisis situations. Further investigations are necessary to comprehend the impact of the pandemic on workplace accidents according to economic activities and professional categories.

Collaborations

CJ Santos Junior: contributed to the study's design, data analysis and interpretation; drafted the article or provided relevant critical review of the content; approved the final version; and is responsible for all aspects of the work and ensuring the accuracy and integrity of the work. KKS Garcia and JLF Antunes: contributed to the critical review of the content; approved the final version; and are responsible for all aspects of the work and ensuring the accuracy and integrity of the work. FM Fischer: contributed to the study's design, data analysis and interpretation; guided the research; provided relevant critical review of the content; approved the final version; and is responsible for all aspects of the work and ensuring the accuracy and integrity of the work.

Funding

FM Fischer receives a productivity scholarship from CNPq (process 306963/2021-3).

References

- Moraes RF. *Medidas Legais de Distanciamento Social: Análise Comparada da Primeira e Segunda Ondas da Pandemia da COVID-19 no Brasil. Nota Técnica nº 33*. Brasília: Ipea; 2021.
- Mattei L, Heinen VL. Impactos da crise da COVID-19 no mercado de trabalho brasileiro. *Braz J Polit Econ* 2020; 40:647-668.
- Bridi MA. A pandemia COVID-19: crise e deterioração do mercado de trabalho no Brasil. *Estud Avan* 2020; 34:141-165.
- Araújo TM, Lua I. O trabalho mudou-se para casa: trabalho remoto no contexto da pandemia de COVID-19. *Rev Bras Saude Ocup* 2021; 46:e27.
- World Health Organization (WHO). *Statement on the fifteenth meeting of the International Health Regulations Emergency Committee regarding the coronavirus disease (COVID-19) pandemic* [internet]. 2023 [cited 2023 set 11]. Available from: [https://www.who.int/news/item/05-05-2023-statement-on-the-fifteenth-meeting-of-the-international-health-regulations-\(2005\)-emergency-committee-regarding-the-coronavirus-disease-\(covid-19\)-pandemic](https://www.who.int/news/item/05-05-2023-statement-on-the-fifteenth-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-coronavirus-disease-(covid-19)-pandemic).
- Brasil. Ministério da Saúde (MS). Gabinete do Ministro. Portaria GM/MS nº 913, de 22 de abril de 2022. Declara o encerramento da Emergência em Saúde Pública de Importância Nacional (ESPIN) em decorrência da infecção humana pelo novo coronavírus (2019-nCoV) e revoga a Portaria GM/MS nº 188, de 3 de fevereiro de 2020. *Diário Oficial da União* 2022; 22 abr.
- Huber D, Frank R, Crevenna R. The impact of lockdowns during the COVID-19 pandemic on work-related accidents in Austria in 2020. *Wien Klin Wochenschr* 2022; 134:391.
- Baek EM, Kim WY, Kwon YJ. The Impact of COVID-19 Pandemic on Workplace Accidents in Korea. *Int J Environ Res Public Health* 2021; 18:8407.
- Ugur D, Mahmut A, Erhan K, Yasin E, Yavuz H. An investigation of the effect of the COVID-19 (SARS-CoV-2) pandemic on occupational accidents (Tokat-Turkey). *Arch Environ Occup Health* 2023; 78(1):28-37.
- Hoffeld K, Pflüger P, Pfföringer D, Hofmeister M, Stuby F, Biberthaler P. Decline in work and commuting injuries during the first lockdown in the SARS-CoV-2 pandemic: Comparison to the time period 2015-2019. *Unfallchirurgie (Heidelb)* 2022; 125(6):467-472.
- Bernal JL, Cummins S, Gasparrini A. The use of controls in interrupted time series studies of public health interventions. *Int J Epidemiol* 2018; 47:2082-2093.
- Antunes JLF, Cardoso MRA. Uso da análise de séries temporais em estudos epidemiológicos. *Epidemiol Serv Saude* 2015; 24:565-576.
- Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa Nacional de Amostra por Domicílios Contínua, PNAD Contínua* [Internet]. 2019 [acessado 2023 set 11]. Disponível em: <https://www.ibge.gov.br/estatisticas/sociais/trabalho/9171-pesquisa-nacional-por-amostra-de-domicilios-continua-mensal.html>.
- Ministério da Previdência Social. *Anuário Estatístico da Previdência Social – AEPS InfoLog* [Internet]. 2019 [acessado 2023 set 11]. Disponível em: <http://www3.dataprev.gov.br/infologo/inicio.htm>.
- Bottomley C, Ooko M, Gasparrini A, Keogh RH. In praise of Prais-Winsten: An evaluation of methods used to account for autocorrelation in interrupted time series. *Stat Med* 2023; 42:1277-1288.
- Turner SL, Karahalios A, Forbes AB, Forbes AB, Taljaard M, Grimshaw JM, Korevaar E, Cheng AC, Bero L, McKenzie JE. Creating effective interrupted time series graphs: Review and recommendations. *Res Synth Methods* 2021; 12:106.
- Moreira MF, Meirelles LC, Cunha LAM. COVID-19 no ambiente de trabalho e suas consequências à saúde dos trabalhadores. *Saude Debate* 2022; 45:107-122.
- Egozi L, Reiss-Hevlin N, Dallahsheh R, Pardo A. Couriers' safety and health risks before and during the COVID-19 pandemic. *Int Arch Occup Environ Health* 2022; 95:589.
- Autor D, Reynolds E. The nature of work after the COVID crisis: Too few low-wage jobs. *Glob Public Health* 2021; 1:408-415.
- Galindo EP, Silva SP, Pedreira Júnior JU. *Impactos factais da COVID-19 nos trabalhadores brasileiros. Nota Técnica nº 27*. Brasília: Ipea; 2022.
- Góes GS, Martins FS, Nascimento JAS. Trabalho remoto no Brasil em 2020 sob a pandemia do COVID-19: quem, quantos e onde estão? *Cart Conjunt IPEA* 2021; 2:1-11.
- Martins TCF, Guimarães RM. Distanciamento social durante a pandemia da COVID-19 e a crise do Estado federativo: um ensaio do contexto brasileiro. *Saude Debate* 2022; 46:265-280.
- Silva LLS, Lima AFR, Polli DA, Razia PFS, Pavão LFA, Cavalcanti MAFH, Toscano CM. Medidas de distanciamento social para o enfrentamento da COVID-19 no Brasil: caracterização e análise epidemiológica por estado. *Cad Saude Publica* 2020; 36:e00185020.
- Ministério do Trabalho, Programa de Disseminação das Estatísticas do Trabalho. *Cadastro Geral de Empregados e Desempregados (Caged)* [Internet]. 2022 [acessado 15 abr 2023]. Disponível em: <http://pdet.mte.gov.br/novo-caged>.
- Mattei L, Heinen VL. Balanço dos impactos da crise da COVID-19 sobre o mercado de trabalho brasileiro em 2020. *Rev Katálysis* 2022; 25:43-61.
- Aquino EML, Silveira IH, Pescarini JM, Aquino R, Souza-Filho JA, Rocha AS, Ferreira A, Victor A, Teixeira C, Machado DB, Paixão E, Alves FJO, Pilecco F, Menezes G, Gabrielli L, Leite L, Almeida MCC, Ortelan N, Fernandes QHRF, Ortiz RJF, Palmeira RN, Pinto Junior EP, Aragão E, Souza LEPF, Barral Netto M, Teixeira MG, Barreto ML, Ichihara MY, Lima RTDSL. Medidas de distanciamento social no controle da pandemia de COVID-19: potenciais impactos e desafios no Brasil. *Cien Saude Colet* 2020; 25(Supl. 1):2423-2446.

27. Ximenes RA, Albuquerque MFPM, Martelli CMT, Araújo TVB, Miranda Filho DB, Souza WV, Ichihara MYT, Lira PIC, Kerr LRF, Aquino EML, Silva AAM, Almeida RLF, Kendall C, Pescarini JM, Brandão Filho SP, Almeida-Filho N, Oliveira JF, Teles C, Jorge DCP, Santana G, Gabrielli L, Rodrigues MS, Silva NJ, Souza RFS, Silva VAF, Barreto ML. COVID-19 no nordeste do Brasil: entre o lockdown e o relaxamento das medidas de distanciamento social. *Cien Saude Colet* 2021; 26(4):1441-1456.
28. Volpatto DT, Resende ACM, Anjos L, Silva JVO, Dias CM, Almeida RC, Malta SMC. Avaliação de Estratégias de Relaxamento do Distanciamento Social para o Brasil e o Estado do Rio de Janeiro. *Trends Comput Appl Math* 2022; 23(2):223-242.
29. Santurtún A, Shaman J. Work accidents, climate change and COVID-19. *Sci Total Environ* 2023; 871:162129.
30. Marinaccio A, Gariazzo C, Brusco A, Bucciarelli A, D'Amario S, Scarselli A, Iavicoli S. Occupational impact in COVID-19 pandemic according to one year of compensation claims in Italy. *Epidemiol Prev* 2021; 45(6):513-521.
31. Anderson DA. O fator sazonal no Brasil. *RAE* 1963; 3(9):41-60.
32. Marques GOLC, Fava VL. Persistência e memória longa sazonal na série de desemprego da região metropolitana de São Paulo. *Econ Apl* 2011; 15(2):177-198.
33. Mesquita JMC, Cordeiro Martins H, Teixeira Dias A, Rabelo A. Impactos da sazonalidade da produção sobre os estoques e lucratividade: Análise do Segmento Industrial Brasileiro. *Contab Vista Rev* 2016; 27:61-80.
34. Karimlou M, Salehi M, Imani M, Hosseini AF, Dehnad A, Vahabi N, Bakhtiyari M. Work-related accidents among the Iranian population: a time series analysis, 2000-2011. *Int J Occup Environ Health* 2015; 21(4):279-284.
35. Hoła B, Topolski M, Szer I, Szer J, Blazik-Borowa E. Prediction model of seasonality in the construction industry based on the accidentality phenomenon. *ACME* 2022; 22:30.
36. Liao CW. Pattern Analysis of Seasonal Variation in Occupational Accidents in the Construction Industry. *Procedia Eng* 2012; 29:3240-3244.
37. Pierce B. The Seasonal Timing of Work-Related Injuries: U.S. Bureau of Labor Statistics. *Mon Labor Rev* 2013; 2371-2381.
38. Bezerra JC, Arantes LJ, Shimizu HE, Merchán-Hammann E, Ramalho WM. A Saúde do Trabalhador no Brasil: Acidentes registrados pela Previdência Social de 2008 a 2014. *Rev Bras Enferm* 2020; 73(6):e20180892.
39. Melo MAS, Coleta MFD, Coleta JAD, Bezerra JCB, Castro AM, Melo ALS, Teixeira RAG, Gomes DB, Cardoso HA. Percepção dos profissionais de saúde sobre os fatores associados à subnotificação no Sistema Nacional de Agravos de Notificação (Sinan). *Rev Adm Saude* 2018; 18(71):1-17.
40. Rodrigues AB, Santana VS. Acidentes de trabalho fatais em Palmas, Tocantins, Brasil: oportunidades perdidas de informação. *Rev Bras Saude Ocup* 2019; 44:e8.

Article submitted 29/06/2023

Approved 16/10/2023

Final version submitted 18/10/2023

Corrected on: 11/03/2025

Chief editors: Maria Cecilia de Souza Minayo, Romeu Gomes, Antônio Augusto Moura da Silva

* This document has an erratum:

<https://doi.org/10.1590/1413-81232024303.21682024>

