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## **Impact of Covid-19 on the Antenatal care services utilization in the region of Guelmim Oued Noun, Morocco**

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## **Abstract**

Globally, the covid-19 pandemic has seriously impacted access to healthcare facilities across the world, although there is little evidence on how the pandemic affects the use of essential healthcare in the world. This study sought to evaluate the impact of the covid-19 pandemic on antenatal indicators in the region of Guelmim Oued Noun, Morocco using the interrupted time-series analysis. The aggregated data was delivered by regional health authorities covering the period from January 2017 to December 2020. The descriptive results revealed a steady decline after the Covid-19 pandemic in Antenatal indicators. The results of the regression model showed a negative impact of the pandemic on the antenatal recruitment rate ( $\beta_2 = -16.14$ ;  $p < 0.01$ ), recruitment rate of women in antenatal visits the 1st quarter of pregnancy ( $\beta_2 = -2.09$ ;  $p < 0.01$ ), antenatal visit completion rate ( $\beta_2 = -18.10$ ,  $p > 0.05$ ), average number of visits/pregnancies ( $\beta_2 = -15.65$ ,  $p < 0.05$ ). The effect of the covid-19 pandemic on antenatal rates was significant for almost the indicators studied. Future studies should be focused on the impact of the pandemic on postnatal and immunization services on the national scale.

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## Introduction

According to the World Health Organization (WHO), coronavirus disease COVID-19 is defined as an acute respiratory disease caused by the recently identified SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2). The first case was reported in Wuhan (China), where there were several cases of pneumonia of unknown etiology. Many countries have declared a state of emergency in December 2019 due to the contagious nature of SARS-CoV-2.(Huang et al. 2020)

In the line with WHO strategic guidelines, Moroccan authorities have taken several non-pharmacological measures to prevent the communicability of the virus across the country. These measures imposed included restrictions on large gatherings, work, school attendance, transportation, and travel restrictions. The objective was to prevent and reduce the transmission of Covid-19. In Morocco, the first COVID-19 case was reported on March 2nd, 2020. On March 16th, 2020, the government announced officially the state's Emergence. In addition, the hospitals and healthcare services had restricted the capacity to deliver essential health services (OECD 2020) . Based on recent statistics published by The World Health Organization, 303 000 maternal deaths occur due to pregnancy and childbirth-related complications each year, with 99% of them occurring in sub-Saharan Africa and Southern Asia (Ayalew and Nigatu 2018) Antenatal care helps to reduce the occurrence of maternal morbidity and mortality by providing information about danger signs, health promotion, birth preparedness, and care for pregnancy complications (Siegel and Mallow 2020). Globally, the Covid-19 outbreak resulted in notable changes in terms of government policies, including the access and utilization of healthcare facilities, especially for the vulnerable population which was disproportionately affected (Siegel and Mallow 2020). Similar to other African countries, the Moroccan government has deployed considerable efforts such as preventive and hospital-based interventions based on the guidelines provided by World Health Organization (WHO) to control the COVID-19 pandemic spread. The antenatal care services are conducted under a Pregnancy Surveillance Program implemented by the Child Health Division of the Department of Health and Social Protection since 1987. During the past decades, the program has shown a significant improvement on national indicators as reported by the recent National Survey on Population and Family Health which showed significant disparities in access to these consultations among residence areas (urban and rural) and socioeconomic levels (Ministry of Health care and social protection 2018). Due to the spread of Covid-19, we hypothesize that antenatal care utilization will decrease

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significantly as a consequence of the combination of multiple factors. Yet, little is known about how the COVID-19 pandemic affected antenatal service delivery in Morocco as well as in African countries.

A recent literature review and meta-analysis showed that access to antenatal services has declined due to the significant impact of the Covid-19 outbreak (Townsend et al. 2021). In the same context, previous studies have demonstrated that many women are unable to obtain family planning services to avoid unwanted pregnancies (McGinn et al. 2011). Another study conducted, in Sri Lanka, has examined the impact of the Coronavirus disease 2019 pandemic on the basic antenatal care received during the pandemic. The effect of the COVID-19 pandemic on the quality of antenatal care was significant (Patabendige, Gamage, and Jayawardane 2021). Siedner et al (2020) found through a systematic review and meta-analysis that lockdowns were highly and significantly associated with the utilization of health services among children. (Siedner et al. 2020). Another systemic review based on 3097 unique references was carried out about the potential change in the access to healthcare facilities during the Covid-19 pandemic. The finding highlighted the significant decrease in visits, admissions, diagnostics, and therapeutics services. (Moynihan et al. 2021) In Kinshasa, the Democratic Republic of the Congo, the COVID-19 outbreak led to a significant reduction in health service utilization (Hategeka et al. 2021). Similarly, in Sindh, Pakistan, the effect of the pandemic of Covid-19 was responsible for the decrease of 52.5% of the daily average total number of vaccinations administered (Chandir et al. 2020).

To the best of our knowledge, this is the first study that examined the effect of the COVID-19 pandemic on Antenatal care services in the region of Guelmim Oued Noun, Morocco using the interrupted times series as a statistical tool. The empirical implication of this study will enable policy-makers to reorganize the healthcare facilities in order to maintain the use of antenatal services at the level recommended in the national health strategy (Health Ministry 2019; Moynihan et al. 2021).

## **Materials and Methods**

**Setting** The Guelmim Oued Noun region (geographic coordinates 28.45°N and 10.11°W) is one of the twelve regions of Morocco which are limited to the north by the Souss-Massa region, to the east by the Moroccan-Algerian borders, to the south by the Laâyoune-Sakia Alhamra region and the Mauritanian borders and to the west by the Atlantic Ocean. The Region of Guelmim - Oued Noun

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includes four (4) provinces: Guelmim, Tan-Tan, Assa-Zag, and Sidi Ifni; fifty-three (53) communes. The area of region Guelmim - Oued Noun, is about 46 108 km<sup>2</sup> and with a population of 433 757 inhabitants according to the recent General Census of Population and Housing (35 % rural).

The regional health system in the region Guelmim Oued is structured under four provincial healthcare districts (Guelmim, Tan-Tan, Sidi Ifni, Assa-Zag). The public healthcare supply consists of 05 public hospitals with a capacity of 375 beds. The total number of healthcare centers is about 99 where 77 are implemented in rural areas. According to regional healthcare authorities, the number of Health care facilities per inhabitant is about 4545. Further, the ratio of inhabitants per public hospital bed is 1200 inhabitants per bed. Alongside the public sector, the private sector is an unavoidable actor in the production of health services in the region (Ministry of Health and Social Protection, 2021). The aggregated data used in this study covered the period from January 2017 to December 2020 to form a continuous time series. The information obtained from regional health authorities contained indicators related to the performance of routine antenatal activities. The data cleaning was carried out to check missing values during the period of the study. The variables selected for this study were chosen based on the availability of data at the regional level and the relevance of these indicators for the monitoring of the Pregnancy and Childbirth Surveillance Program.

### ***Independent variables:***

- The regression model specified for our study included four independent variables:
- “Covid-19 pandemic” is a dichotomic variable that takes the values 0 for the pre-Covid-19 period and 1 for a post-Covid-19 pandemic. The periods before and during the pandemic period constitute the two segments of our regression models. These periods include 38 monthly time points before the pandemic and 10 monthly time points after the covid-19 pandemic.
- “Time before the covid-19 pandemic” indicates the number of months from the start of the observational period (January 2017)
- “Time during Covid-19 pandemic” is a continuous variable indicating time passed since the declaration of the state of emergency (P is equal to 0 before intervention has occurred).
- The interaction between the variable “Time before the covid-19 pandemic” and “time during the covid-19 pandemic”

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### ***Statistical Analysis:***

We used R language to conduct statistical analysis (R Core Team 2021). In the first step, we proceeded to the exploration of our data by using the graphical method, the objective was to describe the general trend of different indicators during the period of the study. Recent literature analysis revealed a growing interest in using interrupted times series (ITA) as a statistical approach for evaluating policy intervention. (Cochrane Effective Practice and Organization of Care [EPOC] 2013) (Mowatt et al. 2001). The use of ITA in this study is more appropriate for assessing the effect of covid-19 on antenatal indicators. The Ordinary Least Squares (OLS) method was used to estimate the model parameters.

### ***Specification of the regression model:***

The segmented regression analysis can be written as (Wagner et al. 2002) :

$$Y_t = b_0 * X_1 + b_1 * X_1 + b_2 * X_2 + b_3 * X_3 + b_4 X_4 + e_t \text{ (Eq. 1)}$$

- $Y_t$  is the outcome at time “t”;
- $b_0$  estimates the base level of the outcome at the beginning of the series (at a time ‘t’= 0);
- $b_1$  estimates the change in outcome per month Before covid-19 pandemic ( $X_1$ );
- $b_2$  estimates the change in level in the Covid-19 pandemic ( $X_2$ );
- $b_3$  estimates the change in trend during a covid-19 pandemic ( $X_3$ );
- $b_4$  estimates the interaction between the time before and during a covid-19 pandemic ( $X_4$ );
- $e_t$  estimates the error.

The validity of our regression model was verified by checking coefficient of determination ( $R^2$ ), adjusted  $R^2$  ( $R^2_{Adj}$ ), F statistic for the significance of the model and Durbin Watson (DW) for autocorrelation between residuals. All statistical tests were two-sided and P-value < 0.05 was reported statistically significant. The statistical analysis was conducted using R version 4.0.0 with additional packages (Grolemund and Wickham 2011).

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## **Results**

A descriptive analysis of the data was primarily conducted to describe the behavior of different indicators during the study period. Then, a comparative overview was performed by comparing the average of the different indicators before and during the covid-19 pandemic. The Percentage of change (%) was used to measure the magnitude of change. The interrupted time series model was performed to assess the impact of the covid-19 pandemic on different antenatal indicators (independent variables).

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## Descriptive analysis

The following graphics present the monthly evolution of antenatal rates between January 2017 to December 2020 in the region Guelmim Oued Noun.



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- (1) Antenatal visit completion rate (%) | (2) Antenatal Recruitment Rate (%) | (3) High-risk pregnancy screening rate (%) | (4) The recruitment rate of pregnant women visits in the 1<sup>st</sup> quarter of pregnancy (%) | (5) The average number of visits/pregnancies.

Figure 3 : Monthly Evolution of prenatal rates from January 2017 to December 2020

Guelmim Oued Noun Region-Morocco

Source: Regional Health and social protection Directory in the region of Guelmim Oued Noun.

The graphs related to antenatal indicators showed a remarkable downward trend since the announcement of the state of emergency in March 2020. According to Figure 3 and Figure 4, the monthly average antenatal recruitment rate shifted from 8 to 3,52 with a decrease of 4.48 points. The average recruitment rate of women in antenatal visits during the first quarter of pregnancy has diminished by 60% compared to the pre-Covid19 period. During the COVID-19 pandemic, the average prenatal visit completion rate dropped from 56.67 % to 29.75 %. The average number of visits per pregnancy has declined by 48 percent, from 2.59 visits before the pandemic to 1.35 visits.

### **Regression Analysis:**

This section presents the parameters of the regression model estimated using the Ordinary Least Square (OLS). Five models were estimated to quantify the impact of the covid-19 pandemic on antenatal indicators.

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Table 4: Estimated Coefficients of the Segmented Regression Model for antenatal indicators (January 2017-December 2020)

Dependent's variables	antenatal recruitment	The recruitment rate of women in antenatal visit at the 1st quarter of pregnancy	antenatal completion rate	average number of visits/pregnancies	High-risk pregnancy screening rate
Covid-19 ( $\beta_2$ )	.14*** (3.80)	.09*** (0.67)	.10 (11.67)	.65** (7.74)	.7*** (0.84)
The time during the Pandemic ( $\beta_3$ )	.17 (6.65)	.09 (1.19)	.17 (21.00)	.11 (14.07)	.10 (1.47)
Time before Pandemic ( $\beta_1$ )	.3 (0.04)	.02 (0.01)	.9 (0.18)	.2 (0.13)	.1 (0.01)
Time before X Time during Pandemic ( $\beta_4$ )	.4 (0.14)	.1 (0.02)	.5 (0.43)	.5 (0.43)	.1 (0.03)
Constant ( $\beta_0$ )	10***	.5***	.58***	.21***	.9***
$R^2$	.3	.3	.9	.3	.1
$R^2_{ajus}$	.3	.3	.5	.1	.9
Durbin Watson ; P-value	.9 ; > 0.05	1.1 ; > 0.05	.9 ; > 0.05	1.1 ; > 0.05	.9 ; > 0.05

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F-statistic ; P-value

4 ; < 0.05

1 ; < 0.05

4 ; < 0.05

3 ; < 0.05

; < 0.05

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According to table 3, each month, the Antenatal recruitment rate increased by 0.03 points. The increase is not statistically significant. ( $\beta_1 = 0.03$ ;  $p > 0.05$ ). The covid-19 pandemic has an immediate effect on the Antenatal recruitment rate as the coefficient is significantly different from zero ( $\beta_2 = -16.14$ ;  $p < 0.01$ ). The trend post- covid19 has a negative impact but not significant at level of 5% ( $\beta_3 = -2.07$ ;  $p > 0.05$ ). The interaction between the time before and during the pandemic is insignificant. Thus, the model estimated by independent variables restituted 80% of the total variance. Regarding the recruitment rate of women in antenatal visits at the first quarter of pregnancy, we noted that the trend before and during the pandemic was negative and insignificant at a level of 5%. The effect of Covid-19 pandemic was statistically significant ( $\beta_2 = -2.09$ ;  $p < 0.01$ ). The variance explained by the model was 70%. Also, the impact of the covid-19 pandemic declined the antenatal visit completion rate by 18.10. The impact was not significant at level of 5% ( $\beta_2 = 18.10$ ;  $p > 0.05$ ). The trend before and during the pandemic was negative and no significant difference was identified at the level of 5%. The coefficient of determination was about 49%. The average number of visits per pregnancy diminished by 0.22 each month. The effect of the pandemic was statistically significant and negative on the average number of visits per pregnancy ( $\beta_2 = -15.65$ ;  $p < 0.01$ ). The trend during the pandemic was negative but not significant at level 5% ( $\beta_3 = -2.51$ ;  $p > 0.05$ ). Thus, the interaction between the trend before and during the pandemic was not significant at the level of 5%. The proportion of the variance explained by the model was 83%. It was noted that the trend of the rate decline before the pandemic decreased continuously by 0.6 points each month. The decrease was insignificant ( $\beta_1 = -0.01$ ;  $p > 0.05$ ). The effect of the covid-19 pandemic on the High-risk pregnancy screening rate was reported negative and highly significant at the level of 1% ( $\beta_2 = -3.47$ ;  $p < 0.01$ ). The power of explanation of the model was about 71%.

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## Discussion

This study shed light on the impact of the Covid-19 pandemic on the use of routine antenatal services using the interrupted time series in the region of Guelmim Oued Noun, Morocco. Our findings revealed a substantial reduction in the Antenatal recruitment rate (-16.14 %), the recruitment rate of women in antenatal visits at the 1st quarter of pregnancy (-2.09%), Antenatal visit completion rate (-18.10 %), The average number of visits/pregnancies (-15.65%), High-risk pregnancy screening rate (-3.47%). Our research was based on the regional and available aggregated data which covered the period from January 2017 to December 2020. The application of interrupted times series showed a significant decrease in overall indicators relative to antenatal services during the period studied. The antenatal services were delivered by both primary health centers and provincial or regional hospital centers in the region. After the Covid-19 outbreak, the essential goal of healthcare authorities was to prevent people from any source of transmission which could endanger their life. In this vein, many decisions have been undertaken to limit mobility inside as well as outside regions. The use of antenatal services was limited to extreme emergencies, especially in public hospitals and telehealth was an optimal alternative to transmit essential information regarding the health status of women and their children.

These results are consistent with previous research. There is a growing consensus that hospital admission and primary health centers access have fallen as a response to the lockdown measures and worries about being infected with the coronavirus.(Li et al. 2020a, 2020b). Another explanation highlighted in the literature is the growth in the expense of transportation for pregnant women and women who do not have access to a private car. During earlier outbreaks in West Africa and South Korea, fear of nosocomial transmission and closure of healthcare facilities was identified as a challenge to healthcare access. (Elston et al. 2015, 2016, Lee and Park 2018) . Thus, many considerations have been identified as contributing factors to accessing medical facilities as previously mentioned in the World Bank Note, including financial factors, a lack of mobility, and fears of contracting Covid-19(Swindle and Newhouse 2021). In the context of our study, the effect of the pandemic on antenatal indicators could be explained mainly by a set of decisions made by regional healthcare authorities to limit Coronavirus transmission such as the reorganization of primary healthcare activities across the regional health territory to participate in activities with respect

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to Covid-10 screening. The paucity of transportation and interdiction of mobility between provinces and regions could be another factor that has contributed to the decrease in the use of antenatal routine services across the region studied.

Also, the rise in transportation costs as a result of the limitation of the number of passengers has contributed to this decline. Fear and anxiety about the persistence of the pandemic may also be responsible for a woman's reluctance to seek antenatal health services. To ensure their continuity, the Ministry of Public health and Social Protection has adopted a protocol-based strategy to tackle the Covid-19 epidemic, alongside preventative measures taken (Ministry of Health and social protection 2020). Nevertheless, the efforts made, the access to maternal and child services remains a major concern for policymakers due to multiple engagements of the government on improving Maternal and child health as stated in Sustainable development objectives (United Nations 2020).

Although the measures taken during the peak of the pandemic in 2020 were successful in circumventing the spread of the Covid-19 virus, it is interesting to note that these decisions had a negative impact on women's access to prenatal services as highlighted in this study. Our ultimate interest in this work is to present a scientific basis for measures taken to reorganize and revitalize programs for the management and screening of high-risk pregnancies at the regional scale. The finality is to draw lessons for better planning of antenatal services in upcoming health crises.

These results should be considered in the context of limitations. Firstly, the aggregated data were used as the basis of statistical analysis which can hide meaningful information such as Age, Gender, and Residence. Secondly, the study covered a period from January 2017 to December 2020. We have restricted our research to current data available from regional health authorities due to the lack of official information for the year (2021). Another intriguing thing to examine is the insufficient number of observations during the covid-19 pandemic, which may limit our ability to understand the pandemic's long-term implications. Moreover, based on the number of observations available (48 months), It was advocated that we reduce the independent variables to four (Trend before epidemic, Trend during pandemic, Covid-19 pandemic, and interaction between time before and during pandemic) to avoid overfitting problem. Additionally, our research focuses only on a single region, making it difficult to generalize our findings to all regions in Morocco which could have different

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behavior toward the decline of these indicators. Such a study should be carried out on a national scale. Another limitation of the current research refers to the multidimensionality of the access to healthcare services which constitutes a real challenge to exclude the exclusive effect of the pandemic from other potential factors.

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## **Conclusion**

Our study highlighted the negative effect of the covid-19 pandemic on the decline of antenatal indicators in the region of Guelmim Oued Noun. To our knowledge, no study has ever been carried out in Morocco to assess the impact of the covid-19 pandemic on access to antenatal care services using advanced quantitative techniques such as interrupted time series.

Future research is supposed to examine how the covid-19 pandemic impacts the antenatal indicators at a national level in order to strengthen policymakers with the information needed to develop more innovative tools and strategies for the upcoming pandemics. Also, it will be also an interesting starting point to conduct a reflection on the use of telehealth as a complementary innovative approach for targeting the medically underserved geographic area in Morocco, especially in the context of pandemic and health crises. Also, further studies are highly recommended to investigate the potential role of public transport in enabling women to access antenatal health facilities, particularly for vulnerable populations such as pregnant women, children, and elderly people. Ensuring the availability of essential healthcare services during the pandemic is a challenging task for policy-makers, particularly in African countries where healthcare systems were fragilized. The tailored approaches based on specific characteristics of the context are highly required to satisfy the needs of pregnant women. Interestingly, the covid-19 highlighted the need for more valid data which could enable policymakers to target more vulnerable groups. The reform of the health information system becomes a must for a better understanding of the behavior of the virus in time and space.

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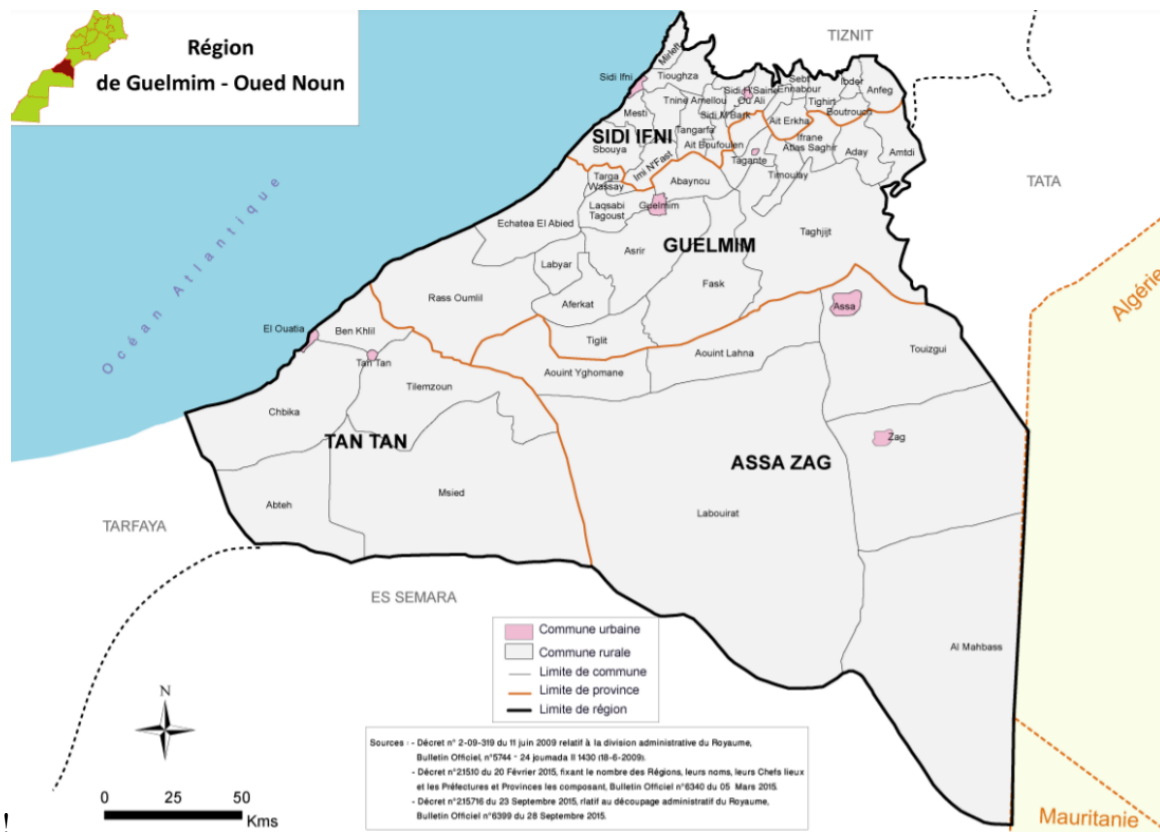
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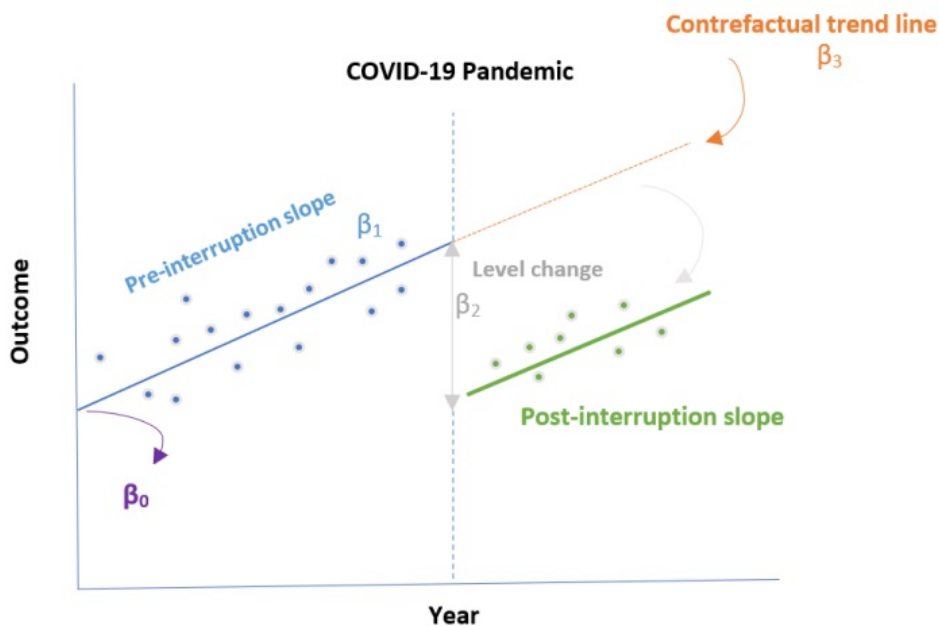


**Figure 1. The geographic map of the region Guelmim Oued Noun, Morocco.**

**Source: High commission of planning (HCP).**

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**Figure 2. Illustration of the interrupted time series analysis to quantify the effect of covid19 pandemic on antenatal indicators, Region Guelmim Oued Noun.**

**Source: Authors' conception**

**Table 1. Antenatal indicators.**

pendents variables	rmula
tenatal recruitment rate (%)	mber of new registrations x 100 / expected births
≥ recruitment rate of pregnant women visits in the 1st quarter of pregnancy (%)	mber of new enrollments including 1st quarter gnancy x 100/ Number of expected births
tenatal visit completion rate (%)	mber of visits at the 9 <sup>th</sup> -month x 100 / Number new enrollments before the 9 <sup>th</sup> -month of gnancy

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average number of visits/pregnancies	total number of antenatal visits / Number of new men enrolled in antenatal
high-risk pregnancy screening rate (%)	(total risk pregnancies screened managed + referred) x 100 / Total antenatal visits)

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Source: Regional Health and social protection Directory in the region of Guelmim Oued Noun,  
Morocco

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