

Impact of COVID-19 on the antenatal care services utilization in the region of Guelmim Oued Noun, Morocco

Jamal Tikouk,¹ Asmaa Ait Boubkr,¹ Mohammed Alami Chentoufi²

¹Laboratory of Applied Modeling in Economics and Management, University Hassan II, Casablanca;

²Laboratory of Mathematical Modeling and Economic Computation, University Hassan I, Settat, Morocco

Abstract

Background. The COVID-19 pandemic has seriously impacted access to healthcare facilities across the world, but there is little evidence of how the pandemic influences the use of essential healthcare in the world.

Objective. This study aimed to evaluate the impact of the COVID-19 pandemic on antenatal indicators in the region of Guelmim Oued Noun, Morocco.

Methods. The aggregated data was delivered by regional health authorities covering the period from January 2017 to December 2020. The interrupted time series was mobilized to conduct statistical analysis.

Results. 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 during the 1st quarter of pregnancy ($\beta_2 = -2.09$; $P < 0.01$), antenatal visit completion rate ($\beta_2 = -18.10$; $P > 0.05$), and average number of visits/pregnancies ($\beta_2 = -15.65$, $P < 0.05$).

Conclusion. The effect of the COVID-19 pandemic on antenatal rates was significant for almost all the indicators studied. Future studies should focus on the impact of the pandemic on postnatal and immunization services on a national scale.

Introduction

According to the World Health Organization (WHO), COVID-19 is defined as an acute respiratory disease caused by the recently identified severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first case was reported in Wuhan (China), where there were several cases of pneumonia of unknown etiology. Many countries declared a state of emergency in December 2019 due to the contagious nature of SARS-CoV-2.¹

In line with WHO strategic guidelines, Moroccan authorities have taken several non-pharmacological measures to prevent the communicability of the virus across the country. These imposed measures included restrictions on large gatherings, work, school attendance, transportation, and traveling. 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 emergency state. In addition, hospitals and healthcare services had restricted the capacity to deliver essential health services.² Based on recent WHO statistics, 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.³ Antenatal care helps reduce the occurrence of maternal morbidity and mortality by providing information about danger signs, health promotion, birth preparedness, and care for pregnancy complications.⁴ 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.⁴ 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 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 in 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.⁵ Due to the spread of COVID-19, we hypothesize that antenatal care utilization will decrease 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.⁶

In the same context, previous studies have demonstrated that many women are unable to obtain family planning services to avoid unwanted pregnancies.⁷ Another study conducted in Sri

Correspondence: Jamal Tikouk, Laboratory of Applied Modeling in Economics and Management, University Hassan II, Casablanca, Morocco.

E-mail: jamal.tikouk-etu@etu.univh2c.ma

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Lanka has examined the impact of the COVID-19 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.⁸ Siedner *et al.* found through a systematic review and meta-analysis that lockdowns were highly and significantly associated with the utilization of health services among children.⁹ 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 a significant decrease in visits, admissions, diagnostics, and therapeutic services.¹⁰ In Kinshasa (Democratic Republic of the Congo), the COVID-19 outbreak led to a significant reduction in health service utilization.¹¹ Similarly, in Sindh, Pakistan, the COVID-19 pandemic was responsible for a decrease of 52.5% in the daily average total number of vaccinations administered.¹²

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 time series as a statistical tool. The empirical implication of this study will enable policy-makers to reorganize the healthcare facilities to maintain the use of antenatal services at the level recommended in the national health strategy.^{10,13}

Materials and Methods

Setting

The Guelmim Oued Noun region (geographic coordinates 28.45°N and 10.11°W) is one of the 12 regions of Morocco and is 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 (Figure 1). The Region of Guelmim Oued Noun includes 4 provinces (Guelmim, Tan-Tan, Assa-Zag, and Sidi Ifni) and 53 communes. The area of the region of Guelmim Oued Noun is about 46,108 km² and has 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 of Guelmim Oued Noun is structured under 4 provincial healthcare districts (Guelmim, Tan-Tan, Sidi Ifni, Assa-Zag). The public healthcare supply consists of 5 public hospitals with a capacity of 375 beds. The total number of healthcare centers is about 99, 77 of which are implemented in rural areas. According to regional healthcare authorities, the number of healthcare facilities per inhabitant is about 4545. Furthermore, 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.¹⁴ 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.

Variables

The regression model specified for our study included 4 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 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 second variable is *time before the COVID-19 pandemic* and it indicates the number of months from the start of the observational period (January 2017). *Time during the COVID-19 pandemic* is a continuous variable indicating the time passed since the declaration of the state of emergency (P=0 before intervention has occurred). The last one is represented by the interaction between the variable *time before the COVID-19 pandemic* and *time during the COVID-19 pandemic*.

Antenatal indicators are reported in Table 1.

Statistical analysis

We used R language to conduct statistical analysis.¹⁵ In the first step, we proceeded with 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].¹⁶ 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:¹⁷

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

where: 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 the 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 the COVID-19 pandemic (X_3); b_4 estimates the interaction between the time before and during the COVID-19 pandemic (X_4); e_t estimates the error.

The validity of our regression model was verified by checking the 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 $P < 0.05$ was reported as statistically significant. The statistical analysis was conducted using R version 4.0.0 with additional packages.¹⁸

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).

Descriptive analysis

Figure 2A-E presents the monthly evolution of antenatal indicator rates between January 2017 to December 2020 in the Guelmim Oued Noun region. The graphs related to antenatal indicators showed a remarkable downward trend since the announce-

ment of the state of emergency in March 2020. 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-COVID-19 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%, 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 OLS. Five models were estimated to quantify the impact of the COVID-19 pandemic on antenatal indicators. 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 had an immediate effect on the antenatal recruitment rate as the coefficient is significantly different from 0 ($\beta_2=-16.14$; $P<0.01$). The post-COVID-19 trend has a negative impact but is not significant at the 5% level ($\beta_3=-2.07$; $P>0.05$). 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 in the first quarter of pregnancy, we noted that the trend before and during the pandemic was negative and insignificant at the 5% level. The effect of the 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 the 5% level ($\beta_2=-18.10$; $P>0.05$). The trend before and during the pandemic

was negative and no significant difference was identified at the 5% level. 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 the 5% level ($\beta_3=-2.51$; $P>0.05$). Thus, the interaction between the trend before and during the pandemic was not significant at the 5% level. 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%.

Data are reported in Table 2.

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 (Figure 3). 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 available aggregated data which covered the period from January 2017 to December 2020.

Table 1. Antenatal indicators.

Dependents variables	Formula
Antenatal recruitment rate (%)	Number of new registrations \times 100/expected births
The recruitment rate of pregnant women visits in the 1st quarter of pregnancy (%)	Number of new enrollments including 1st quarter pregnancy \times 100/number of expected births
Antenatal visit completion rate (%)	Number of visits at the 9th month \times 100/number of new enrollments before the 9th month of pregnancy
The average number of visits/pregnancies	Total number of antenatal visits/number of new women enrolled in antenatal
High-risk pregnancy screening rate (%)	Total risk pregnancies screened (managed+referred) \times 100/total antenatal visits

Table 2. Estimated coefficients of the segmented regression model for antenatal indicators (January 2017-December 2020).

Independent variables	Antenatal recruitment rate	Recruitment rate of women in antenatal visits at the 1 st quarter of pregnancy	Antenatal visit completion rate	Average number of visits/pregnancies	High-risk pregnancy screening rate
COVID-19 (β_2)	-16.14*** (3.80)	-2.09*** (0.67)	-18.10 (11.67)	-15.65** (7.74)	-3.47*** (0.84)
Time during the pandemic (β_3)	-2.07 (6.65)	-0.29 (1.19)	-3.37 (21.00)	-2.51 (14.07)	-0.60 (1.47)
Time before the pandemic (β_1)	0.03 (0.04)	-0.002 (0.01)	-0.19 (0.18)	0.22 (0.13)	-0.01 (0.01)
Time before \times time during pandemic (β_4)	0.04 (0.14)	0.01 (0.02)	0.06 (0.43)	0.05 (0.43)	0.01 (0.03)
Constant (β_0)	38.10***	3.56***	60.68***	31.21***	9.30***
R ²	0.80	0.70	0.49	0.83	0.71
R ² _{ajus}	0.78	0.68	0.46	0.81	0.69
Durbin Watson; P-value	2.00 ; >0.05	2.01 ; >0.05	2.09 ; >0.05	2.11 ; >0.05	1.89 ; >0.05
F-statistic ; P-value	42.4 ; <0.05	25.1 ; <0.05	10.4 ; <0.05	51.3 ; <0.05	26.4 ; <0.05

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. 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 admissions and primary health centers access have fallen as a response to the lockdown measures and worries about being infected with the coronavirus.¹⁹ 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.^{20,21} 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-19.²²

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 COVID-19 transmission, such as the reorganization of primary healthcare activities across the regional health territory to participate in activities concerning COVID-19 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 women’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.²³

Nevertheless, the efforts made, and the access to maternal and



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

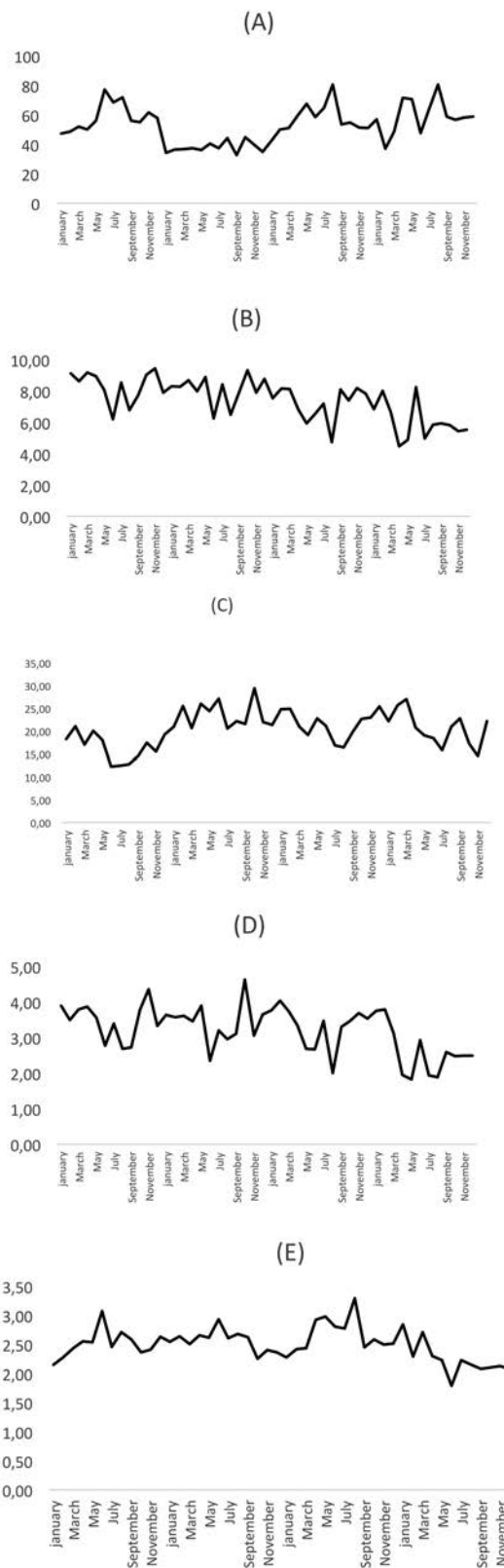


Figure 2. A-E. Monthly evolution of antenatal rates between January 2017 to December 2020 in the region Guelmim Oued Noun. A) Antenatal visit completion rate (%); B) Antenatal Recruitment Rate (%); C) High-risk pregnancy screening rate (%) D) The recruitment rate of pregnant women visits in the 1st quarter of pregnancy (%) E) The average number of visits/pregnancies.

child services remain major concerns for policymakers due to multiple engagements of the government on improving maternal and child health as stated in the sustainable development objectives.²⁴

Although the measures taken during the peak of the pandemic in 2020 were successful in circumventing the spread of COVID-19, 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 objective is to draw lessons for better planning of antenatal services in upcoming health crises.

Limitations

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 4 (trend before the epidemic, trend during the pandemic, COVID-19 pandemic, and interaction between the time before and during the pandemic) to avoid the 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 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 access to healthcare services which constitutes a real challenge to exclude the exclusive effect of the pandemic from other potential factors.

Conclusions

Our study highlighted the negative effect of the COVID-19 pandemic on the decline of antenatal indicators in the region of

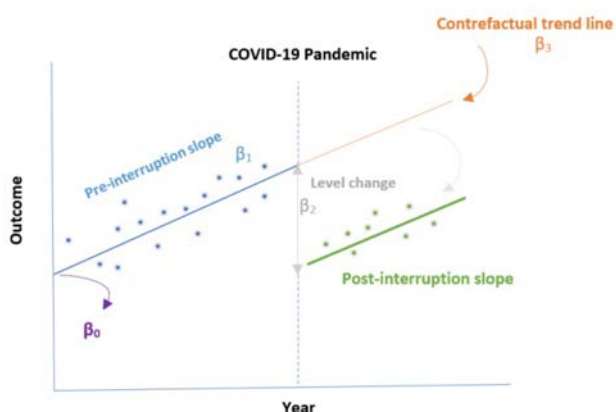


Figure 3. Illustration of the interrupted time series analysis to quantify the effect of the COVID-19 pandemic on antenatal indicators, Guelmim Oued Noun region.

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 to strengthen policymakers with the information needed to develop more innovative tools and strategies for the upcoming pandemic situations. Also, it will be 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.

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 are fragile. The tailored approaches based on specific characteristics of the context are highly required to satisfy the needs of pregnant women. Interestingly, 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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