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A tale of two times: an exploration of healthcare utilization patterns before and during COVID-19 in Iran

Satar Rezaei^{1*}  and Masoud Mohammadnezhad^{2,3,4}

Abstract

Background The COVID-19 pandemic has impacted global healthcare utilization patterns. This study aimed to examine the impact of COVID-19 pandemic on utilization rate of healthcare services in Iran.

Method In this quasi-experimental study, data on the utilization rates of laboratory services, sonography exams, CT scans, MRIs, and EKGs was collected from the Social Security Organization (SSO)'s insurance information system. This data, covering 47 months prior to the pandemic and 25 months during it, was analyzed to assess the pandemic's impact on healthcare utilization among insured individuals in Iran. The data was categorized into direct, indirect, and total sectors, and an Interrupted Time Series Analysis (ITSA) model was employed for data analysis, examining both total and sector-specific utilization rates.

Findings : The study for single group indicated that in the total sector, Utilization rate per 1000 insured significantly decreased by 25.25 for laboratory services, decreased by 3.99 for sonography, decreased by 1.08 for MRIs and decreased by 1.01 for EKGs, but increased by 2.28 for CT scans in the first pandemic month. Over following months, monthly utilization trends per 1000 insured increased significantly- laboratory services + 1.08, sonography + 0.11, CT scans + 0.12, MRIs + 0.06, and EKGs + 0.05. Pre-pandemic, monthly utilization per 1000 insured was 62.68 labs, 14.47 sonography, 0.72 CT scans, 2.06 MRIs, with all significantly higher in the indirect over direct sector except EKGs which were 2.08 higher in the direct sector. In the first pandemic month, there were significant between-sector differences per 1000 of -4.4 for sonography, + 1.89 CT scans, -1.01 MRIs and + 1.29 EKGs.

Conclusion The COVID-19 pandemic led to a significant decline in healthcare service utilization, particularly in total and direct sectors, while CT scans remained unaffected. To address these challenges and meet patient needs, Iran's health system should adopt alternative delivery methods like telemedicine.

Keywords COVID-19 pandemic, Social security organization, Health services utilization, Time series analysis

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Introduction

The COVID-19 pandemic in late 2019 has impacted health service utilization and its delivery patterns in all countries regardless of their economic and social status. The pandemic also forcing health systems to change their health service delivery models because of lockdowns and stay-at-home orders to some extent in response [1, 2]. A systematic review [3] found that during the COVID-19 pandemic, patients faced reduced and delayed access to routine in-person healthcare services. However, the review also showed a significant increase in the use of telemedicine as an alternative method of care delivery. Previous studies have indicated that the pandemic has led to fluctuations in hospital admission rates, bed occupancy rates, laboratory services, CT and MRI usage, average hospital stay durations, and emergency department visits [4–12].

Iran's healthcare system, like many other countries, faced significant challenges due to the COVID-19 pandemic, which began affecting the nation in early 2020. The pandemic was officially declared in Iran after the first COVID-19 death was recorded in Qom on February 19, 2020 [13]. The virus rapidly spread to all provinces across Iran shortly thereafter. An important point that must be considered during a pandemic is how the health system responds to the essential needs of non-COVID-19 patients. During a pandemic, people reduce their demand for health services for various reasons such as fear of contracting the illness, quarantine policies, etc [14, 15]. This situation can have adverse effects on individuals and the health system in terms of disease progression, costs, and more. Research studies carried out in Iran have demonstrated the pandemic's impact on healthcare utilization within the country [6, 11, 12]. A study by Ahmadi et al. [16] found that the COVID-19 pandemic substantially reduced hospitalizations for nine different diseases in Iran. However, health policymakers and planners in all countries must quantify both the positive and negative consequences of the pandemic, as doing so will enable them to apply these insights in future crises to better address patient needs.

During a pandemic like COVID-19, health policymakers must evaluate the level of access and utilization of different types of health services across various time periods, both before and during the pandemic, as well as across different organizations, in order to design effective interventions for the optimal allocation of scarce resources. However, there is a lack of national-level quantitative studies on this topic in Iran [11]. The current study introduces several key innovations that differentiate it from prior studies. First, our research encompasses a broader population coverage by analyzing data from all provinces in Iran, which includes over 44 million insured individuals under the Social Security

Organization (SSO). This represents more than 50% of Iran's population, while the previous study focused on a smaller sample size. Second, we employed an extended time frame for our analysis, evaluating healthcare utilization over 72 months, including 47 months prior to the pandemic and 25 months during it. In contrast, the previous study only analyzed a shorter period before and during the pandemic, limiting its temporal scope. Third, our research provides a comprehensive assessment of healthcare services by examining a wider range of services, including laboratory services, sonography exams, CT scans, MRIs, and EKGs. The previous study primarily focused on a limited set of healthcare services, such as hospitalization, medication, laboratory services, and radiology. Finally, our study differentiates between direct and indirect sectors of the SSO, while the previous study compared public and private healthcare sectors. These distinctions highlight the originality and relevance of our research in understanding the effects of the COVID-19 on healthcare utilization in Iran. Therefore, to fill this gap in the literature, this study aimed to examine the short-term (immediate effect) and long-term impacts of the COVID-19 pandemic on the monthly utilization of laboratory services, sonography exams, CT scans, MRIs, and EKGs performed per 1,000 insured individuals by the Social Security Organization (SSO) across direct, indirect, and total sectors. We hope the results of this study will help increase the resilience of the Iran's health system in future crises, mitigate declines in essential health care and enable optimal allocation of resources.

Social security organization (SSO)

The SSO plays a crucial role, providing health insurance and services to over 44 million employed Iranians, which is more than 50% of the population. The SSO operates its own network of healthcare facilities including hospitals, clinics, pharmacies, rehabilitation centers, etc. across Iran. It directly provides medical services to its insured members through this infrastructure (direct sector). In addition to its own facilities, the SSO has contracts with private hospitals, labs, physicians' offices, etc. to provide care to insured patients (indirect sector). This integrated approach allows insured members to access both direct and indirect healthcare services, with financing derived from member premiums and government contributions. Understanding this structure is essential for evaluating the impact of the COVID-19 pandemic on healthcare utilization among SSO beneficiaries in Iran [17–19].

Method and materials

This quasi-experimental study analyzed data from those insured by Iran's SSO health insurance at the national and provincial levels. The SSO covers approximately 44,000,000 people, representing over 50% of the

country's population in 2021. We utilized monthly data on laboratory services, sonography exams, CT scans, MRIs and EKGs performed over 72 months- 47 pre-pandemic months and 25 pandemic months. The data was extracted from the SSO's insurance information system and categorized into direct, indirect, and total sectors [20]. The first confirmed case of COVID-19 in Iran was reported on 19 February 2020, marking the onset of the outbreak in the country [21]. Therefore, the pre-pandemic period was defined as 20 March 2016 to 19 February 2020. The pandemic period was 20 February 2020 to 20 March 2022. Population data of those covered by the SSO health insurance was retrieved from their insurance information system to calculate utilization rates of the various services before and during the pandemic. Since month-specific insured individual counts were unavailable, annualized data was used to calculate the rates.

To analyze the data, descriptive statistics and univariate analysis (using the Mann–Whitney test) were first applied to compare the average number of utilization 47 months before and 25 months after the onset of COVID-19. In this study, we used Excel and STATA version 17 software for data analysis. In STATA, we utilized the “*itsa*” package to examine the impact of the pandemic on the utilization of the health services. To compare the mean utilization of health services before the pandemic for the direct sector, indirect sector and the total sector, we used the Mann-Whitney U test. To measure the stationarity of the data, we applied the generalized Dickey-Fuller test and to investigate heterogeneity in the data, we used the Breusch–Pagan test. In all analyses, a 5% level was considered as the level of statistical significance.

The application of conventional epidemiological methods, such as randomized clinical trials, to evaluate the effects of various interventions presents several challenges. These challenges stem from ethical and political considerations, difficulties in implementing randomization, and the necessity of assessing interventions retrospectively. This is especially true for interventions or events that occur at the societal level, where the use of such methods is often impractical. In cases where clinical trials are not feasible due to these constraints, the Interrupted Time Series Analysis (ITSA) method serves as a valuable quasi-experimental design for evaluating the impact of interventions or events on health outcomes [22, 23]. In this study, we employed the ITSA method to evaluate the effects of the COVID-19 pandemic on the utilization of health services. Specifically, ITSA allows for the assessment of changes in time series data by comparing periods before and after an event, enabling us to analyze the impact of the pandemic on healthcare service usage effectively. The ITSA is a robust method for examining the effects of both planned and unplanned events on healthcare utilization, as demonstrated through other

studies [11, 24–28]. We used the single-group ITSA to examine the impact of the pandemic on the outcome variables (laboratory services, sonography exams, CT scans, MRIs and EKGs performed per 1000 insured) for whole covered population by the SSO regardless of the route of the care that they have received (direct or indirect) and multiple-group ITSA was used to assess the impact of the pandemic on utilization of the outcome variables in direct sector versus indirect sector.

The ITSA model includes two key variables- level and trend- to indicate the impact of an intervention or event. The level variable captures immediate effects, representing the change occurring immediate after the intervention. It also represents the average value of the outcome variable at a given time point. The trend variable captures long-term, sustained effects over time following the intervention. Analyzing these two variables allows assessment of both the immediate, short-term impacts of an event and gradual, longer-term changes in outcomes over time following the intervention [29].

We used the following regression as a single group ITSA [29]:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 T_t X_t + \varepsilon_t$$

Where Y_t shows the monthly utilization rate per 1000 insured individuals for the studied health services (laboratory, sonography, CT, MRI, EKG). T_t is a continuous time variable indicating time in months from 1 to the total number of months. X_t is a binary indicator variable coded as 0 for the pre-pandemic period and 1 for the pandemic period. $T_t X_t$ represents the number of months after the start of the pandemic. β_0 estimates the baseline level of the outcome at the start, β_1 estimates the pre-pandemic trend over time, β_2 estimates the level change immediately after the start of COVID-19, and β_3 estimates the change in trend after COVID-19 compared to the pre-pandemic trend.

The following segmented regression model was used for multi group ITSA [29]:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 T_t X_t + \beta_4 Z + \beta_5 Z T_t + \beta_6 Z X_t + \beta_7 Z T_t X_t + e_t$$

Where Y_t shows the monthly utilization rate per 1000 insured individuals for the studied health services (laboratory, sonography, CT, MRI, and EKG); T_t is a continuous time variable indicating time in months from 1 to the total number of months; X_t is a binary variable representing pre/during pandemic periods (0=pre, 1=during); Z is a binary variable representing direct vs. indirect sectors (0=direct, 1=indirect); $T_t X_t$, $Z T_t$, $Z X_t$, $Z T_t X_t$ are interaction terms; β_0 is the intercept or the starting level of the outcome variable (Y) in the direct sector; β_1

Table 1 Descriptive of the outcome variables included in the study

Outcome variables		Before the pandemic Mean (SD)	During the pandemic Mean (SD)	Change %	Z	p-value
Laboratory tests per 1000 insured	Direct sector ^A	19.6 (1.7)	14.3 (2.4)	-27.0	6.64	< 0.001
	Indirect sector	85.8 (8.3)	81.1 (14.6)	-5.5	1.55	< 0.001
	Total	103.7 (13.5)	95.8 (16.2)	-7.6	2.83	0.004
Utilization rate of sonography per 1000 insured	Direct sector	1.5 (0.5)	1 (0.2)	-33.3	4.20	< 0.001
	Indirect sector	15.5 (1.6)	12.2 (2.2)	-21.3	5.90	< 0.001
	Total	16.6 (2.8)	13.2 (2.3)	-20.5	5.71	< 0.001
Utilization rate of CTS per 1000 insured	Direct sector	0.5 (0.06)	1.2 (0.4)	140.0	-6.95	< 0.001
	Indirect sector	1.3 (0.1)	4.4 (1.5)	238.5	-6.95	< 0.001
	Total	1.8 (0.18)	5.6 (1.8)	211.1	-6.95	< 0.001
Utilization rate of MRI per 1000 insured	Direct sector	0.3 (0.04)	0.2 (0.07)	-33.3	0.54	0.612
	Indirect sector	2.6 (0.4)	2.8 (0.7)	7.7	-1.31	0.190
	Total	2.8 (0.5)	3.1 (0.7)	10.7	-1.36	0.173
Utilization rate of EKG per 1000 insured	Direct sector	3.1 (0.3)	2.1 (0.4)	-32.3	6.77	< 0.001
	Indirect sector	0.9 (0.3)	1.0 (0.2)	11.1	-2.33	0.021
	Total	4.1 (0.4)	3.2 (0.6)	-22.0	5.71	< 0.001

A: The SSO provides health services to insured patients in two main ways- direct and indirect sectors. In the direct sector, healthcare facilities owned by SSO including hospitals, clinics, pharmacies, rehabilitation centers, etc. provide free treatment and medicines to patients. In the indirect sector, the SSO has contracts with hospitals/medical centres affiliated with medical universities, private hospitals, labs, physicians' offices, etc. to provide care to insured patients. Patients often prefer the direct sector because it is free. But this causes long wait times. Patients who can afford it may go to the indirect sector for quicker access

Table 2 Single group analysis of the effect of the COVID-19 pandemic on selected healthcare services among those insured by the SSO

	Laboratory		Sonography		CT		MRI		EKG	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Mean value at the baseline (β_0)	106.10	< 0.001	19.02	< 0.001	0.74	0.171	2.81	< 0.001	4.45	< 0.001
Pre-trend (β_1)	0.16	0.238	-0.03	0.305	0.007	0.338	0.02	< 0.001	-0.02	< 0.001
Post-level change (β_2)	-25.25	< 0.001	-3.99	< 0.001	2.28	0.001	-1.08	< 0.001	-1.01	< 0.001
Post-trend change (β_3)	0.92	0.018	0.15	0.025	0.11	0.034	0.04	0.002	0.07	< 0.001
Post-intervention linear trend	1.08	0.002	0.11	0.020	0.12	0.023	0.06	< 0.001	0.05	< 0.001
Model significance (F, p-value)	6.33, < 0.001		9.78, < 0.001		13.35, < 0.001		17.25, < 0.001		15.30, < 0.001	

represents the pre-pandemic slope or the trend over time in Y in the direct sector before the pandemic; β_2 represents the level change or the change in Y in direct sector during the pandemic; β_3 represents the difference in slope or trend in Y between before and during the pandemic in direct sector; β_4 is the difference in baseline Y between direct and indirect sectors before the pandemic; β_5 is the difference in pre-pandemic trends in Y between direct and indirect sectors; β_6 represents the difference in level change in Y in the first month of the pandemic period between direct and indirect sectors; β_7 is the differences in slope changes in Y from pre-pandemic to pandemic periods between direct and indirect sectors and e_t is the error term.

Results

Table 1 shows descriptive statistics for monthly utilization rates per 1,000 insured individuals for laboratory tests, sonography, CTS, MRI and EKG before and during the COVID-19 pandemic by direct, indirect and total sectors. In the direct sector, the mean monthly rate of laboratory tests per 1,000 population decreased from

19.6 (SD=1.7) pre-pandemic to 14.3 (SD=2.4) during the pandemic. Similarly, the monthly EKG rate declined from 3.1 pre-pandemic to 2.1 during the pandemic. In the total sector, the monthly rates of laboratory tests, sonography, and EKGs decreased by 7.6%, 20.5%, and 22.0%, respectively, compared to pre-pandemic levels. However, the rates for CT scans and MRIs increased by 211.1% and 10.7%, respectively, over the same period. As it is indicated from the Table 1, the changes for all the outcome variables except for the MRI utilization were statistically significant for all three sectors- direct, indirect, and total - when comparing the during pandemic period to the pre-pandemic period.

The results of the single group analysis for utilization of laboratory tests, sonography, CT scans, MRIs, and EKGs per 1,000 insured individuals for the total sector are reported in Table 2. The starting level per 1,000 insured were 106.10 for laboratory tests, 19.02 for sonography, 0.74 for CTS, 2.81 for MRI, and 4.45 for EKG. The starting levels for all services except CT scans were statistically significant (p -value<0.05). In the first month of the pandemic, the number of laboratory tests, sonography,

MRI and EKG per 1000 insured decreased significantly by 25.25, 3.99, 1.08 and 1.01 per 1000 insured, respectively. In the first month after the pandemic onset, there were significant decreases in monthly utilization rates per 1000 insured for laboratory tests (-25.25), sonography exams (-3.99), MRIs (-1.08) and EKGs (-1.01). However, the CT scan utilization rate increased significantly by 2.28 per 1000 in the first month after the pandemic onset. Over the months of the pandemic, there were significant increasing trends per 1000 insured for all five services: laboratory tests (+1.08), sonography (+0.11), CT scans (+0.12), MRIs (+0.06), and EKGs (+0.05). Figure 1 provides the visual display results of the five variables included in the study before and during the COVID-19 pandemic for total sector.

In the direct sector, the utilization of laboratory tests decreased significantly by about 7.04 per 1000 insured in the first month of the pandemic and increased

significantly by about 0.26 per 1000 insured in the post-pandemic months. The starting level of utilization of laboratory services before the pandemic was 62.68 per 1000 insured higher in the indirect sector than the direct sector, and this difference was statistically significant. In the first month of the pandemic, there was a significant (at the 10% level) decrease in utilization of laboratory services for both the indirect and direct sectors. This reduction for the indirect sector compared to the direct sector was 15.51 per 1000 insured higher. (Table 3; Fig. 2A).

The starting level of utilization of sonography, CTS, and MRI before the pandemic was 14.47, 0.72 and 2.06 per 1000 insured, significantly higher in the indirect sector than the direct sector. The onset monthly utilization of EKGs before the pandemic was 2.08 higher in the direct sector than the indirect sector, which was significant. Prior to the pandemic, there were no significant differences in trends for utilization of sonography exams,

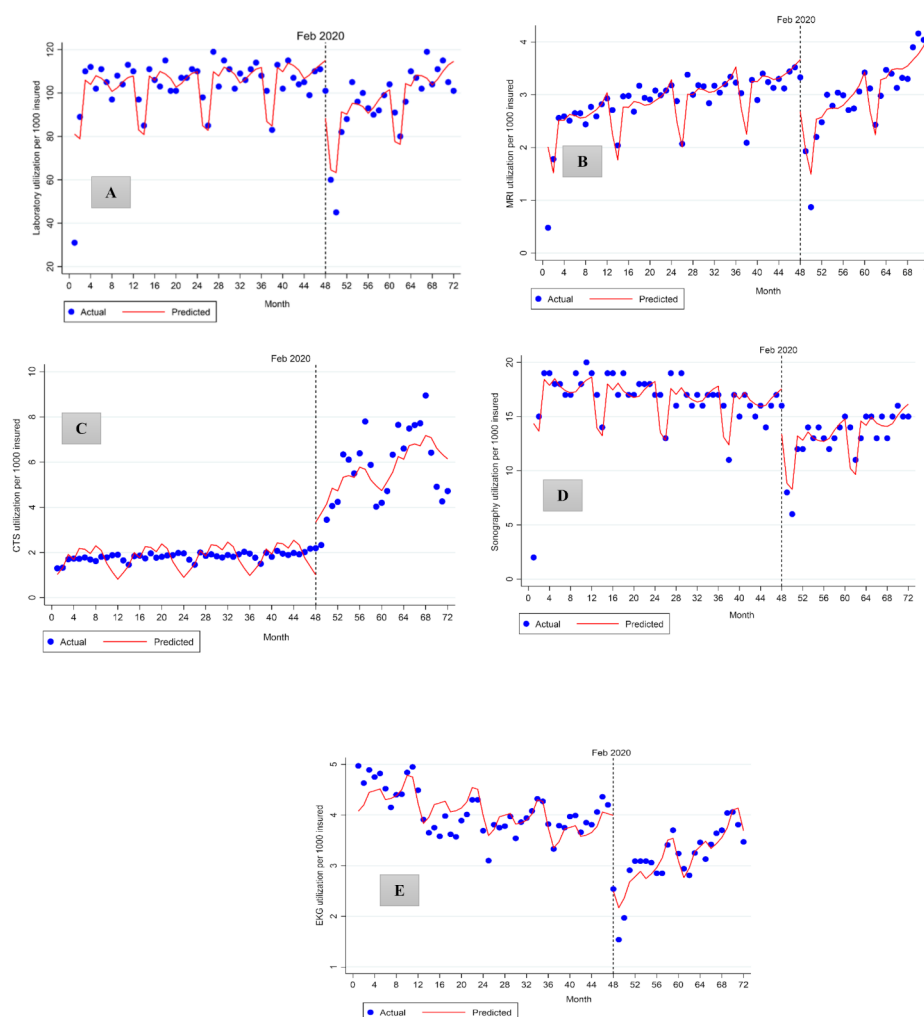


Fig. 1 Effect of COVID-19 pandemic on the healthcare utilization among those insured by the SSO in Iran (A: laboratory tests; B: sonography; C: CTS; D: MRI; and E: EKG)

Table 3 Multiple group analysis of the effect of the COVID-19 pandemic on utilization of laboratory tests, sonography, CTS, MRI and EKG per 1000 insured by the SSO in the direct sector versus indirect sector

		Laboratory		Sonography		CT		MRI		EKG	
		Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Direct sector	Before the pandemic	20.46	<0.001	1.90	<0.001	0.46	<0.001	0.21	<0.001	3.21	<0.001
	Mean value at the baseline (β_0)										
	Pre-trend (β_1)	-0.04	0.009	-0.02	<0.001	0.003	<0.001	0.002	<0.001	-0.003	0.278
during the pandemic	During-level change (β_2)	-7.04	<0.001	-0.15	0.266	0.41	0.006	-0.15	<0.001	-1.29	<0.001
	During-trend change (β_3)	0.26	0.001	0.03	0.001	0.016	0.325	0.005	0.001	0.036	0.001
	Pre-level difference (β_4)	62.68	<0.001	14.47	<0.001	0.72	<0.001	2.06	<0.001	-2.08	<0.001
Indirect sector relative to direct sector ^A	Before the pandemic	0.15	0.016	-0.02	0.124	0.002	0.258	0.01	<0.001	-0.006	0.196
	During-level difference (β_6)	-15.51	0.059	-4.44	<0.001	1.89	0.015	-1.01	<0.001	1.29	<0.001
	Change in slope difference pre-to during (β_7)	0.88	0.073	0.20	0.001	0.04	0.515	0.05	<0.001	0.002	0.826
Model significance	F	1016.84		1617.44		286.35		891.10		333.63	
	p-value	<0.001		<0.001		<0.001		<0.001		<0.001	

A: The SSO provides health services to insured patients in two main ways- direct and indirect sectors. In the direct sector, healthcare facilities owned by SSO including hospitals, clinics, pharmacies, rehabilitation centers, etc. provide free treatment and medicines to patients. In the indirect sector, the SSO has contracts with hospitals/medical centres affiliated with medical universities, private hospitals, labs, physicians' offices, etc. to provide care to insured patients. Patients often prefer the direct sector because it is free. But this causes long wait times. Patients who can afford it may go to the indirect sector for quicker access

CT scans, and EKGs per 1000 insured between the direct and indirect sectors. However, it was a statistically significant for utilization of MRIs per 1000 insured. There was a statistically significant difference between direct and indirect sectors in the level of utilization of sonography, CTS, MRI and EKG was -4.4, 1.89, -1.01 and 1.29 per 1000 insured in the first month of the onset pandemic (Table 3; Fig. 2B and E).

Discussion

It is clear that health system and the pattern of healthcare delivery in all countries has been significantly impacted by the COVID-19 pandemic. These changes in the healthcare system also occurred in Iran. One of the big health insurance companies in Iran is the SSO. The SSO also provides healthcare services. In 2022, it provided health insurance to about 45 million people across all 33 provinces of Iran. The SSO directly provides medical services to its insured members through its own facilities (direct sector). In addition, the SSO has contracts with private hospitals, labs, physicians' offices, etc. to provide care to insured patients (indirect sector). The current study aimed to examine the effect of COVID-19 pandemic on utilization of different healthcare services including laboratory services, sonography exams, CTS, MRI and EKG among those insured by the SSO in the direct and indirect sectors.

The findings indicated that in the total sector, utilization rate of laboratory services, sonography exams, MRI and EKG has been significantly decreased in the first month of the pandemic. Despite the initial decrease observed in the first month (short term period) of the pandemic, an overall upward trend (long term period) was observed in utilization rate for laboratory services, sonography exams, MRI and EKG throughout the pandemic period. In a study examining insured individuals under the IHIO in Fars province, Rezaei et al. [11] found significant declines in the short-term and substantial long-run increases utilization of private laboratory and radiology services following the pandemic. In another study in Iran [6] it showed that the use of both outpatient and inpatient services in hospitals and clinics significantly declined during the COVID-19 outbreak and the utilization of these services had still not rebounded to pre-outbreak levels as of June 2021. Similar to our findings for MRI usage, Mahmood Pour-Azari et al. [12] reported that in the first month of the pandemic, there was a significant 81% decrease in utilizing MRI compared to the pre-COVID-19 baseline level. However, after the initial reduction, there were significant monthly increases in the utilization of MRI during the pandemic. The short-term decrease in healthcare utilization right after the pandemic onset, followed by a long-term increase in utilization over time, has been thoroughly documented

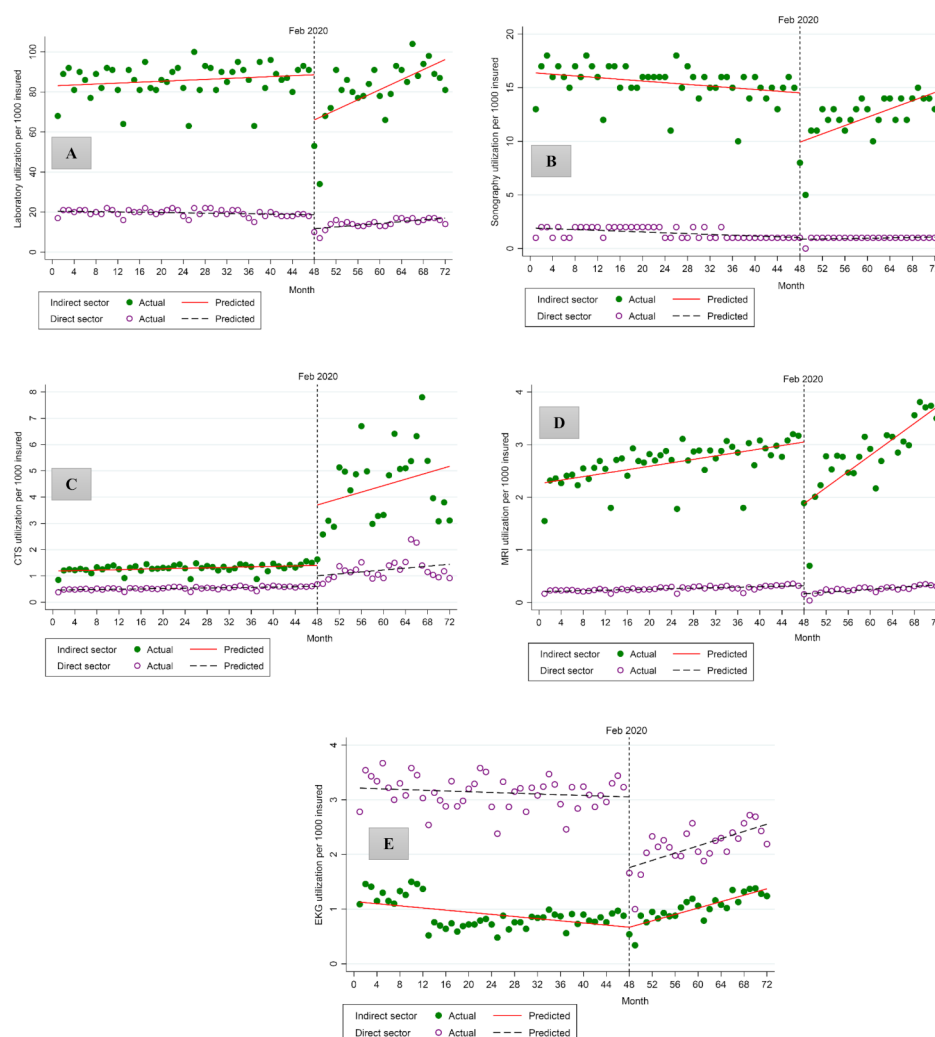


Fig. 2 The effect of the COVID-19 pandemic on utilization of laboratory tests, sonography, CTS, MRI and EKG per 1000 insured by the SSO in the direct sector versus indirect sector (**A**: laboratory tests; **B**: sonography; **C**: CTS; **D**: MRI; and **E**: EKG). Note: The SSO provides health services to insured patients in two main ways- direct and indirect sectors. In the direct sector, healthcare facilities owned by SSO including hospitals, clinics, pharmacies, rehabilitation centers, etc. provide free treatment and medicines to patients. In the indirect sector, the SSO has contracts with hospitals/medical centres affiliated with medical universities, private hospitals, labs, physicians' offices, etc. to provide care to insured patients. Patients often prefer the direct sector because it is free. But this causes long wait times. Patients who can afford it may go to the indirect sector for quicker access

across previous studies [30–32]. The authors of these studies concluded that decreased healthcare services utilization may have been attributable to fear of getting the virus in medical centers, lock-down policies and ministry of health's recommendations that discouraged seeking health care unless severely sick. However, the combination of these factors can significantly reduce the utilization of healthcare services. We noted notable variations in the utilization of various health services, such as laboratory tests, sonography, MRI, and EKG, when comparing the periods before and during the pandemic. The indirect sector generally showed higher utilization rates for these services, except for EKG, which was more frequently utilized in the direct sector. Additionally, the initial decline

in service utilization during the pandemic was more pronounced in the indirect sector for laboratory services, sonography, and MRI, while EKGs saw a greater reduction in the direct sector during the same period. Similar to our findings, a study indicated that during the first month of the pandemic, there was a notable decline in the utilization of private laboratory services, radiology, medication, and hospital admissions [11].

The utilization rate of CT scans increased in the first months of the pandemic and remained elevated in the following months as well. Similar to our findings, in a study conducted in Iran about the impact of COVID-19 on the number of CT-scans, there was a significant increase in the use of CT scans in public hospitals

following the emergence of the first COVID-19 case [24]. This increase in CT scan usage during the pandemic can be attributed to several factors. First, healthcare providers require quicker and more accurate diagnoses to treat patients. Second, as reported in other studies [24, 33], CT scans have been proven as an essential tool for the diagnosing of the COVID-19 disease. In a study in the USA, Loftus et al. [34] showed that weekly usage of CT scans in the emergency department per 100 visits increased from 35.9 scans in pre-pandemic to 41.8 scans in post-pandemic. In the direct sector relative to indirect sector, there is no statistically significant between direct and indirect sectors in pre-pandemic trend and change in slope difference pre-to during pandemic. However, in the first month of the pandemic onset, the utilization rate of CT scan was 1.89 per 1000 insured higher in indirect sector than direct sector. Overall, both before and during the pandemic, over third-fourths of all CT scans performed were provided by indirect sector. The higher use of CT scan in indirect sector could be attributed to limited access to CT scanner in direct sector in some provinces, therefore, some patients with social security insurance are forced to refer to the indirect sector to receive services.

The study findings suggest that the Iranian healthcare system may lack adequate resilience to crises like the COVID-19 pandemic. This is evidenced by the substantial declines in health service use, during the pandemic, which failed to rebound to pre-pandemic levels- signaling unmet needs that could appear long-term. One key recommendation for Iranian policymakers to improve healthcare system resilience to future crises is exploring alternative service delivery approaches like virtual and remote care. This would establish an agile system minimizing delays in providing essential services. Looking internationally, other countries, mostly high-income ones, successfully compensated for reduced in-person services by adopting virtual care. For instance, in Canada, virtual care comprised 50% or more of outpatient visits over the first 9 months of the pandemic [35], with similar patterns in the USA [36], where telemedicine rose 154% in March 2020 versus March 2019. Such cases offer valuable lessons for lower income countries like Iran to enhance telemedicine and virtual capabilities to meet unfulfilled health service needs during and after the pandemic.

This study has several advantages that are noteworthy. First, we utilized two approaches –single group interrupted time series analysis (for total sector) and multiple group interrupted time series analysis (for direct and indirect sectors)– to assess the impact of the COVID-19 pandemic on included healthcare service utilization in the study. Second, we used data on insured individuals from the SSO across 33 provinces in Iran, allowing

us to generalize the findings to the entire country. The total population covered by the SSO's health insurance was around 44 million in 2021, representing over 50% of Iran's total population. A third strength was the use of appropriate pre- and post-pandemic time points (sample size in time series analysis) in our analyses (47 months for pre-pandemic and 25 months for during the pandemic). In most interrupted time series studies, authors commonly mentioned small number of time points as a study limitation [11]. Finally, we examined the effect of COVID-19 pandemic on various health services, including laboratory, sonography, CTS, MRI and EKG services. Despite the mentioned advantages, the current study also has some limitations. We used the data from a single health insurance organization, even though it covers more than 50% of Iran's total population. Second, in this study, we utilized aggregated monthly data for our analysis. The use of aggregated data instead of individual-level data limits our ability to control for confounding variables such as age, sex, socioeconomic status, comorbidities, and regional disparities. Individual-level data could offer more precise insights into how various demographics were affected by the pandemic. Future studies should investigate how these factors at the individual level influence the utilization patterns observed in this analysis. Another limitation of this study is that government policies implemented during the pandemic, such as quarantine measures and social distancing, may have affected healthcare utilization due to shifts in both patient and provider behaviors. However, since these policies generally lasted less than a month and our data were aggregated on a monthly basis, analyzing this aspect was not feasible due to the absence of specific data. Additionally, the study focused on specific healthcare services, including laboratory tests, sonography, CT scans, MRIs, and EKGs, and did not encompass other essential services such as outpatient visits, surgeries, vaccinations or mental health services. This exclusion may limit the overall understanding of the pandemic's impact on healthcare utilization. Finally, it is essential to recognize potential limitations regarding the accuracy and completeness of data obtained from the SSO's records. Variations in data quality could affect the reliability of our findings and should be taken into account when interpreting the results.

Conclusion

Our study demonstrated that healthcare utilization in the direct and indirect sectors of the SSO, except for CTS usage, decreased statistically significant in the first month of the pandemic onset (short term), but we observed upward trend (long term) in utilization rate of all healthcare services included in the study during the pandemic period. Our study showed that resilience in the Iranian

healthcare system is not in good condition and in the first month of the pandemic, the utilization of healthcare services sharply decreased. It is suggested that Iranian health policymakers and planners seek to use telehealth services as an alternative to provide in-person services in future crises and under normal conditions so that they can respond to people's healthcare needs. Nevertheless, given the nature of the data used in this study, which was collected on a monthly basis, it was not possible to assess the impact of other policies such as outbreak peaks, vaccination rollouts, or regional variations in responses (e.g., lockdown severity, healthcare infrastructure). It is recommended that future studies focus on these topics so that policymakers and health system planners can better design and implement interventions.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-024-20452-6>.

Supplementary Material 1

Author contributions

S.R. and M.M. developed the idea, collected and analyzed the data and drafted the initial report. MM critically reviewed the paper, offering comments on the first draft. MM and SR collaborated on implementing the revisions and producing the final edition of the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

We used aggregate utilization data from the database of the Social Security Organization so informed consent was not required. The use of the database for this research purpose was approved by the Social Security Research Institute which granted permission to access and use the data (no: 2014012470). Also, the ethics committee of the Deputy of Research at Kermanshah University of Medical Sciences reviewed and approved the study protocol (IR.KUMS.REC.1402.3835). Based on these approval codes, informed consent for the study was obtained from the Ethics Committees of Kermanshah University of Medical Sciences and the Social Security Research Institute prior to conduction of the research.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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