



Estimating the Economic Burden of COVID-19: Findings from Southern Iran

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Abstract:

Background and Objective: COVID-19 is an acute respiratory disease that poses a significant threat to public health. Recognizing the impact and costs associated with this disease can assist policymakers in making informed decisions about the allocation of resources. Therefore, this study estimated the economic burden of COVID-19 from a societal perspective, focusing on patients admitted to the referral hospital for this disease in southern Iran in 2022.

Methods: This descriptive and analytical study employed a random sampling method to select patients admitted to hospitals affiliated with Jiroft University of Medical Sciences in southern Kerman, Iran. The sampling period spanned from March 2020 to February 2021. In total, 450 patients were included in this study. A researcher-made checklist was used as the data collection tool. The data were then analyzed using a t-test, ANOVA, and Pearson correlation coefficient. The analysis was performed using SPSS23, with the significance level set at 0.05.

Results: The study estimated the total direct cost, total indirect cost, total cost of the studied patients, and the economic burden of COVID-19 disease as 600,211.89, 193,667.28, 793,879.17, and 4,186,389.48 dollars, respectively. A statistically significant correlation was found between length of stay ($r=0.858$, $p<0.001$), type of insurance ($F=2.853$, $P=0.023$), and total direct cost.

Conclusion: Based on these results, it is evident that COVID-19 has imposed a substantial economic burden. The study findings emphasize the need for decision-makers to take measures and implement effective interventions to address COVID-19. This can be achieved by controlling risk factors, drawing upon successful experiences from other countries, and following recommendations provided by international organizations. By reducing the number of infections, the economic burden associated with the disease can be alleviated.

Keywords: Cost of illness, Health care costs, Health economics, Hospital costs, COVID-19, Respiratory Disease.

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1. INTRODUCTION

The rapid spread of COVID-19 across various parts of

the world has raised significant concerns in numerous countries as they encounter a large number of COVID-19 cases [1]. Iran officially declared the outbreak of this

disease on February 18, 2020, and it is currently experiencing its seventh wave. Given the virus's ability to spread rapidly, the reported incidence and mortality rates continue to be alarming [2].

While the primary and most crucial aspect of an epidemic is the suffering and loss of human lives, its impact extends beyond the healthcare system and affects all sectors of the country [3]. The economic sector is one of the areas profoundly affected by epidemics. Previous studies have emphasized the economic consequences of epidemics or pandemics, demonstrating their significant effects on the overall economy. Estimates suggest that the total economic loss caused by epidemics such as influenza amounts to approximately 500 billion dollars annually, equivalent to 0.6% of global income [4].

The economic impact of epidemic diseases varies across income groups, with middle and low-income countries experiencing more severe consequences than high-income countries [5]. The joint report by the World Health Organization and World Bank highlights the significant impact of epidemics. For instance, a report from the United Nations Development Program in 2017 estimated that the Zika virus epidemic in Latin America and the Caribbean from 2015 to 2017 incurred costs ranging from 7 to 18 billion dollars [4].

In recent decades, healthcare costs worldwide have increased significantly [6]. Consequently, health policymakers and planners have recognized the importance of understanding the economic costs associated with diseases. This understanding is crucial for evaluating the allocation of healthcare resources across different disease categories and for assessing the potential benefits of public health interventions [7]. These costs can arise directly from the diagnostic and therapeutic services provided to patients or indirectly from the loss of productivity and quality of life [6].

Illness costs can be categorized into two main groups: direct and indirect costs. Direct costs refer to the expenses incurred directly in providing healthcare services to patients. This includes both direct medical and non-medical costs. On the other hand, indirect costs pertain to the economic impact of the patient's lost productivity due to illness [8].

Direct costs are further divided into two subcategories: direct clinical and direct non clinical costs. Direct clinical costs contain expenses related to hospitalization, surgeries, outpatient visits, radiation therapy, and chemotherapy/immunotherapy. Direct non clinical costs, borne by patients and their families, include transportation costs to healthcare centers and expenses related to complementary and alternative medicines [9].

European data demonstrate substantial macro-economic consequences of the COVID-19 pandemic, with an average decline in GDP of 7.4% in 2020. These effects vary among countries within the region. Without appropriate policy measures, it is estimated that the pandemic will disproportionately affect lower-income individuals, leading to increased poverty rates and overall

inequality [10]. The US Council of Economic Advisers also projected that in the absence of economic support policies, low income individuals would experience an average loss of over 10% of their disposable income in the first quarter of 2020.

Initially, there was a scarcity of cost data regarding the burden of COVID-19, as is the case with any new disease. However, owing to the profound economic burden of this disease, numerous studies have recently focused on the medical costs of COVID-19 in different regions. Given the increasing number of these studies and their significant implications for healthcare budgets and the global economy, it is crucial to understand and consolidate these data to provide policymakers with a comprehensive understanding of the overall burden of COVID-19 [11].

A study conducted by Bartsch *et al.* (2020) in the US revealed that the infection rate of COVID-19 resulted in direct medical costs amounting to 163.4 billion dollars. The average direct medical cost for a symptomatic patient, including infection and one-year post hospital discharge, was \$3,994. For hospitalized COVID-19 patients, the average cost was \$18,579, considering the infection and one-year post-hospital discharge. Interestingly, the costs of hospitalization for COVID-19 patients were relatively similar across all age groups [11].

In the study by Gedik *et al.* (2020), the average clinical cost for patients with COVID-19 was reported to be $\$881.75 \pm 667.31$. For patients requiring Intensive Care Unit (ICU) treatment, the average cost was $\$2924 \pm 2347.14$ [12].

Based on a study by Darab (2021) conducted in Iran, the total direct medical costs for COVID-19 patients in a referral hospital in Fars province were estimated to be \$1,791,172. Among the cost items, the highest cost was attributed to hospitalization, totaling \$735,510. The average direct medical cost was estimated to be \$3,755. The highest indirect costs were associated with the loss of productivity due to premature death, amounting to \$10,190, whereas the lowest indirect costs were related to the loss of income due to hospitalization, totaling \$378 [13].

To assess the economic burden of a disease, it is necessary to calculate both direct costs associated with resource allocation to medical care and indirect costs resulting from the economic resources and opportunities lost due to the disease and its treatment [9]. Gathering information on direct and indirect costs provides health policymakers with an understanding of the economic burden imposed by COVID-19 on governments, health insurance systems, and individuals. Such studies generate evidence to guide the rational allocation of limited resources to the healthcare sector during decision making processes [14]. Additionally, these studies can identify diseases that are more valuable in reducing the overall disease burden [15].

Several studies have been conducted in Iran to calculate the economic burden of various diseases, including cardiovascular diseases [16], eye diseases [17], hepatitis B

[18], breast cancer [9], thalassemia [19], hepatitis C infection [20], and road accidents [21]. However, limited research has been conducted to evaluate the economic burden of this disease, which has become an epidemic in society. Therefore, this study aimed to calculate the economic burden of COVID-19 in patients hospitalized in 2022.

According to what was said, in this research, we looked for the answers to the following questions:

What are the direct and indirect costs of hospitalized patients with Covid-19?

What is the economic burden of COVID-19 in patients hospitalized?

The findings of this research, while helping to expand knowledge about the costs of the COVID-19 pandemic, have developed the awareness of health system managers and policy makers about the economic burden of such pandemics and can be a basis for planning to prepare for future similar crises.

2. METHODS

2.1. Design and Setting

This descriptive-analytical and microeconomic evaluation study used a random sampling method among patients hospitalized in hospitals affiliated with Jiroft University of Medical Sciences in Southern Kerman, Iran, between March 2020 and February 2021. The hospitals included in this study were Imam Hossein, Imam Khomeini, Ayatollah Kashani, 12 Farvardin, Seyyed al-Shohada, and Shohada.

2.2. Participants

According to the following formula, the estimated sample size was 384 individuals. However, to enhance the validity of the results, we increased the sample size to 450 individuals. This figure was chosen based on the number of inpatients in the studied hospitals and the number of inpatients in different months, using a stratified simple random sampling approach.

The sample size of required patients in each of Imam Hossein, Imam Khomeini, Ayatollah Kashani, 12 Farvardin, Seyyed al-Shohada, and Shohada hospitals was estimated as 33, 208, 62, 89, 30, and 28, respectively.

$$n = Z^2 pq / d^2$$

$$P = q = 0.5$$

$$Z = 1.96$$

$$d = 0.05$$

2.3. Instruments

The data collection tool used in this study was a checklist developed by the researchers. This checklist includes various demographic characteristics of the patients, such as age, sex, length of stay, discharge method, and type of insurance, as well as direct costs associated with visits, consultations, nursing services, pharmaceutical services, CT scans, ECG, laboratory tests, dialysis, radiology procedures, ultrasound, MRI, ward equipment, hoteling, and bed

charges. Furthermore, the checklist incorporated relevant information needed to estimate indirect costs, such as the per capita GDP of Iran, the average daily wage rate, and the average number of days patients stayed in the hospital.

2.4. Procedures and Statistical Analysis

To collect information about direct costs, the researchers (ARY) referred to the accounting unit of the studied hospitals and obtained patients' invoices from the Health Information System (HIS) within the desired time period. The checklist of direct costs was completed based on these invoices.

For calculating indirect costs, the human capital approach was employed as follows:

2.4.1. Estimating the Economic Loss in Potential Production due to Mortalities

The economic loss in potential production due to mortalities was determined by multiplying the GDP per capita by the average years of life lost due to premature death. In this study, Iran's GDP per capita in 2021 was estimated based on the Central Bank report, and the average years of life lost due to premature death were calculated using the number of patients who died between the ages of 15 and 65 years.

2.4.2. Estimating the Economic Burden of Lost Productivity due to Illness and Disability

The economic burden of lost productivity due to illness and disability was calculated by multiplying the average days of hospitalization by the average daily wage rate and the total number of patients.

It should be noted that the average daily wage rate in 2021 was determined to be 15.16 dollars, according to a report by the Ministry of Cooperation, Labor, and Social Welfare of Iran.

2.4.3. Indirect Costs Related to the COVID-19

The indirect cost was estimated by adding the economic loss in potential production due to mortalities to the economic burden of lost productivity due to illness and disability. The economic burden of COVID-19 was then calculated using the following formula:

Economic burden of COVID-19 = total mean cost per person (total direct costs + total indirect costs) divided by the total number of studied patients (450) multiplied by the number of patients with COVID-19 in the studied period [13].

Demographic and cost information of the patients was collected confidentially and imported into SPSS23 without disclosing the patients' names. The data were analyzed using descriptive and inferential statistical methods, including Pearson correlation coefficient, T-test, and ANOVA, with a significance level of $\alpha = 0.05$.

3. RESULTS

3.1. Demographic Characteristics of the Study Patients

The mean age of the patients included in the study was

55.88 ± 19.11 years, with the majority (18.89%) falling within the age range of 61 to 70 years. The majority of the patients were male (51.3 percent), and a significant portion had health insurance (69.8 percent). On average, the patients stayed in the hospital for a duration of 5.56 ± 4.14 days, with the majority (49.55%) being hospitalized for less than 5 days. Furthermore, 87.34% of patients recovered and were discharged from the hospital. Table 1 shows the frequency distribution of study patients.

3.2. Frequency of Services Provided to the Study Patients

Based on the findings, the highest number of services provided to the study patients was related to pharmaceutical services, with an average of more than 9,000 drugs administered (equivalent to an average of 22.05 drugs per patient) (Table 2).

Table 1. Demographic characteristics of the study patients (n=450).

Variable	Group	Number	Percent
Sex	Female	219	48.7
	Male	231	51.3
Age (year)	< 20	3	0.67
	20-30	35	7.78
	31-40	79	17.56
	41-50	72	16
	51-60	68	15.11
	61-70	85	18.89
	71-80	52	11.55
	81-90	40	8.89
	>90	16	3.55
Length of stay (day)	<5	223	49.55
	5-10	189	42
	11-15	25	5.56
	16-20	6	1.34
	> 20	7	1.55
Type of insurance	Therapeutic services	314	69.8
	Social security	106	23.6
	Armed forces	14	3.1
	Others	8	1.8
	Without insurance	8	1.8
Discharge method	Recovered	393	87.34
	Passed away	36	8
	Transferred	7	1.56
	Discharged with personal consent	14	3.1

Table 2. Frequency of services provided to the study patients (n=450).

Type of Service	Frequency	Mean	Standard Deviation
Visit	3276	7.28	8.60
Consultation	270	0.60	1.24
Nursing	459	1.02	3.44
CT scan	400	0.89	0.71
ECG	513	1.14	1.42
Laboratory	2799	6.22	6.60
Medications	9922	22.05	17.50
Radiography	99	0.22	0.65
Ultrasound	58	0.13	0.41
MRI	5	0.01	0.07
Dialysis	18	0.04	0.52
Ward equipment	5668	12.59	12.96
Hoteling and bed	2484	5.52	4.03

Table 3. Portions of primary and supplementary insurances, subsidies, patient contributions, and non-subsidized expenses in the total direct costs of study patients (N=450).

Category	Amount	Mean	SD	Percent Out of the Total Costs
Primary insurance	503458.21	1118.79	1425.02	83.88
Subsidy	27008.46	60.01	109.21	4.50
Supplementary insurance	4459.33	9.90	81.67	0.74
Patient	56219.69	124.93	235.85	9.37
Non-subsidized expenses	9066.18	20.14	169.20	1.51
Total	600211.89	1333.80	1315.02	100

Note: * The figures are denominated in US dollars.

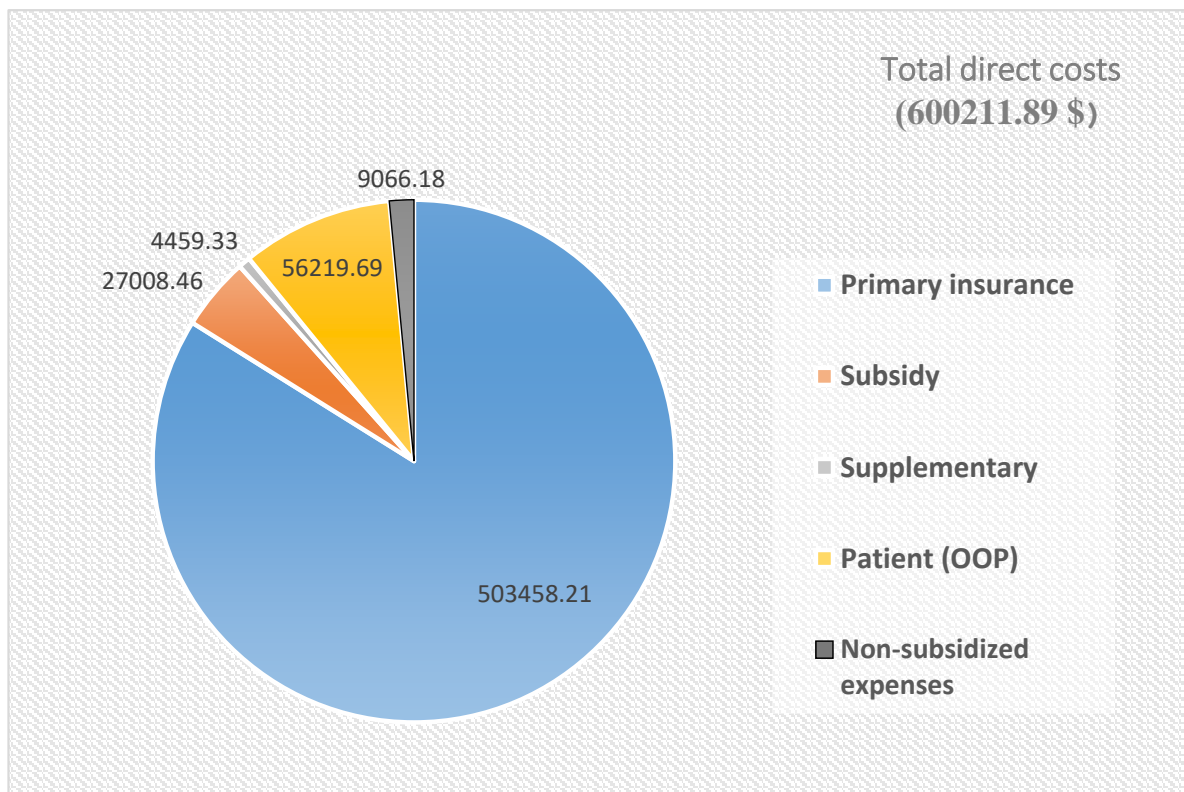


Fig. (1). Portions of primary and supplementary insurances, subsidies, patient contributions, and non-subsidized expenses in the total direct costs of study patients.

3.3. Direct Costs of all Study Patients

Based on these findings, the total direct cost was calculated to be \$600,211.89. Out of this total amount, primary insurance accounted for 83.88% (\$503,458.21), subsidies accounted for 4.50% (\$27,008.46), supplementary insurance accounted for 0.74% (\$4,459.33), patients contributed 9.37% (\$56,219.70), and 1.51% (\$9,066.18) were non-subsidized expenses. These figures are summarized in Table 3 and Fig. (1).

The results showed that among the types of services, pharmaceutical services accounted for the most direct costs, with 40.74% of the total costs (\$244,578.16) (Tables 4 and 5).

3.4. The Relationship between the Direct Costs and Demographic Variables of the Study Patients

Based on the data presented in Table 6, a statistically significant correlation was found between age and the costs associated with visits, consultations, nursing services, CT scans, ECG, ultrasound, MRI, ward equipment, and hoteling and bed. This indicates that as age increased, the costs associated with these services increased ($p < 0.05$). Additionally, a statistically significant relationship was observed between the length of stay and both the total direct cost and direct costs categorized by service type. As the length of stay increased, the direct costs associated with specific services and the total direct cost increased ($p < 0.05$).

The findings indicated a statistically significant relationship between the type of insurance and the costs of visits, dialysis, and total direct costs ($p < 0.05$). Additionally, a statistically significant relationship was

observed between the method of discharge, costs of consultation, nursing services, CT scans, laboratory tests, ultrasound, MRI, ward equipment, and hoteling and bed ($p < 0.05$).

Table 4. Portions of primary and supplementary insurances, subsidies, patients, and non-subsidized expenses in the direct costs of study patients based on type of service.

Type of Service	Total Amount	Total Primary Insurance	Total Subsidy	Total Supplementary Insurance	Total Patient Contribution	Total Non-subsidized Expenses	Percent out of Total Cost
Visit	82105.05	77269.20	1218.39	159.97	2967.17	503.18	13.67
Consultation	9081.04	9527.99	161.99	16.04	313.85	67.97	1.51
Nursing	9018.74	8467.36	231.85	30.32	821.47	146.72	1.50
CT scan	11672.33	10462.81	244.23	37.50	748.82	162.33	1.94
ECG	2158.84	1996.31	44.5942619	3.93	117.72	20.67	0.36
Laboratory	39550.31	35428.60	1027.23	149.72	3081.43	573.20	6.59
Medication	244578.16	192173.09	12861.20	2668.44	28238.85	0	40.74
Radiography	648.51	593.45	15.85	0.59	43.53	4.24	0.10
Ultrasound	1330.21	1224.95	32.47	12.86	59.91	8.10	0.22
MRI	111.11	101.18	1.24	2.48	6.20	0	0.01
Dialysis	1192.23	1158.41	12.45	0	21.36	0	0.19
Ward equipment	17587.30	5151.94	6171.03	675.69	5643.03	11.82	2.93
Hoteling and beds	153990.51	136444.32	2938.98	585.73	12597.39	2445.45	25.65

Table 5. Mean (SD) portions of primary and supplementary insurances, subsidies, patient contributions, and non-subsidized expenses in the direct costs of study patients based on type of service (n=450).

Type of Service	Mean (SD)					
	Total Amount	Primary Insurance	Subsidy	Supplementary Insurance	Patient Contribution	Non-subsidized Expenses
Visit	182.45 (196.36)	171.70 (188.29)	2.70 (5.96)	0.35 (2.54)	6.60 (13.03)	1.11 (9.62)
Consultation	20.18 (44.40)	21.17 (55.52)	0.36 (1.46)	0.035 (0.46)	0.69 (2.91)	0.15 (2.60)
Nursing	20.04 (2.67)	18.81 (33.41)	0.51 (1.16)	0.06 (0.54)	1.82 (5.65)	0.32 (4.02)
CT scan	25.93 (24.40)	23.25 (20.37)	0.54 (0.88)	0.08 (0.66)	1.66 (3.49)	0.36 (3.32)
ECG	4.79 (6.25)	4.43 (5.85)	0.09 (0.20)	0.008 (0.07)	0.26 (0.49)	0.04 (0.41)
Laboratory	87.88 (64.69)	78.73 (59.30)	2.28 (3.92)	0.33 (2.24)	6.84 (13.94)	1.27 (11.98)
Medication	543.50 (729.17)	427.05 (525.75)	28.58 (68.23)	5.94 (68.01)	62.75 (147.07)	0 (0)
Radiography	1.44 (4.23)	1.31 (3.89)	0.03 (0.12)	0.001 (0.02)	0.09 (0.42)	0.009 (0.20)
Ultrasound	2.95 (11.86)	2.72 (11.01)	0.07 (0.34)	0.02 (0.36)	0.13 (0.66)	0.01 (90.38)
MRI	0.24 (2.6)	0.22 (2.37)	0.002 (0.05)	0.005 (0.11)	0.01 (0.17)	0 (0)
Dialysis	2.64 (34.08)	2.57 (33.72)	0.02 (0.48)	0 (0)	0.04 (0.63)	0 (0)
Ward equipment	39.08 (92.70)	11.44 (41.06)	13.71 (36.10)	1.50 (20.68)	12.54 (26.76)	0.02 (0.55)
Hoteling and bed	342.20 (476.33)	303.21 (428.15)	8.75 (20.34)	1.30 (11.03)	27.99 (77.09)	5.43 (67.11)

Note: * The figures are denominated in US dollars.

Table 6. Relationship between demographic variables and direct costs of the study patients.

Demographic Variable	Direct Costs	Pearson Coefficient Correlation	P-value
Age	Visit	0.096	0.042
	Consultation	0.317	0
	Nursing services	0.109	0.02
	CT scan	0.127	0.007
	ECG	0.115	0.014
	Laboratory	0.198	0
	Medication	-0.025	0.6
	Radiography	0.031	0.5
	Ultrasound	0.141	0.003
	MRI	0.111	0.019
	Dialysis	0.044	0.35
	Ward equipment	0.135	0.004
	Hoteling and bed	0.101	0.032
Total direct cost	0.081	0.08	
Length of stay	Visit	0.868	0
	Consultation	0.305	0
	Nursing services	0.855	0
	CT scan	0.29	0
	ECG	0.129	0.006
	Laboratory	0.688	0
	Medication	0.504	0
	Radiography	0.148	0.002
	Ultrasound	0.199	0
	MRI	0.107	0.023
	Dialysis	0.264	0
	Ward equipment	0.541	0
	Hoteling and bed	0.859	0
Total direct cost	0.858	0	
Demographic variable	Direct costs	F-value	P-value
Type of insurance	Visit	2.627	0.034
	Consultation	1.363	0.246
	Nursing services	0.931	0.446
	CT scan	1.849	0.118
	ECG	1.298	0.27
	Laboratory	1.548	0.187
	Medication	2.331	0.055
	Radiography	0.444	0.777
	Ultrasound	0.814	0.517
	MRI	0.071	0.991
	Dialysis	1.256	0
	Ward equipment	1.074	0.369
	Hoteling and bed	1.364	0.245
	Total direct cost	2.853	0.023
Method of discharge	Visit	1.002	0.406
	Consultation	1.206	0
	Nursing services	2.665	0.032
	CT scan	3.108	0.015
	ECG	1.885	0.112
	Laboratory	4.053	0.003
	Medication	0.482	0.749
	Radiography	0.552	0.698
	Ultrasound	3.964	0.004
MRI	4.361	0.002	
Dialysis	0.224	0.925	

(Table 8) contd....

Demographic Variable	Direct Costs	Pearson Coefficient Correlation	P-value
Method of discharge	Ward equipment	7.529	0
	Hoteling and bed	2.431	0.047
Total direct cost	1.517	0.196	
Demographic variable	Direct costs	T value	P-value
Sex	Visit	1.107	0.552
	Consultation	0.448	0.532
	Nursing services	0.037	0.271
	CT scan	1.568	0.158
	EKG	0.761	0.192
	Laboratory	0.911	0.495
	Medication	0.81	0.643
	Radiography	0.378	0.245
	Ultrasound	0.166	0.639
	MRI	0.95	0.057
	Dialysis	1.181	0.019
	Ward equipment	0.505	0.067
	Hoteling and bed	0.067	0.371
	Total direct cost	0.973	0.728

Note: * Significance level of 0.05.

Moreover, a statistically significant correlation was found between sex and dialysis costs when examining the relationship between demographic variables and direct costs. Specifically, the mean cost of dialysis was higher in men (4.49 ± 46.46) than in women (0.71 ± 10.38).

3.4.1. Indirect Costs of all Study Patients

3.4.1.1. The Economic Loss in Potential Production due to Mortalities

The economic loss in potential production due to mortalities (\$155,736.96) = GDP per capita (\$9,733.56) × Average years lost due to premature death (16 years).

Given that out of the 36 patients who died, only seven people were of productive age (15-65 years), the average years lost due to premature death were calculated based on the age information of these seven people.

According to a report by the Central Bank, the GDP per capita of Iran in 2021 was considered 9733.56 dollars.

3.4.1.2. The Economic Burden of Lost Productivity due to Illness and Disability

The economic burden of lost productivity due to illness and disability (\$37,930.32) = average hospital stays (5.56 days) × average daily wage rate (\$15.16) × total number of patients (N= 450)

3.4.2. Indirect Costs

Indirect costs (\$193,667.28) = the economic loss in potential production due to mortalities (\$155,736.96) + the economic burden of lost productivity due to illness and disability (\$37,930.32).

3.4.2.1. The Total Cost (Direct and Indirect) of the Study Patients

Total cost (direct and indirect) of the study patients (\$793,879.17) = total direct costs (\$600,211.89) + total indirect costs (\$193,667.28)

3.4.2.2. Estimating the Economic Burden of Patients with COVID-19 Hospitalized in the Study Hospitals in a One-year Period (from the patient's point of view)

Economic burden of patients with COVID-19 hospitalized in the study hospitals (\$4186389.48) = total mean cost per person (direct costs (\$600211.89) + indirect costs (\$193667.28) divided by the total number of study patients (450)) × the number of patients with COVID-19 in the study hospitals (N=2373)

The number of patients with COVID-19 in the study hospitals was 2373 people.

4. DISCUSSION

The COVID-19 pandemic has had a significant impact on the Iranian health system and society, resulting in a heavy economic burden [22]. This study aimed to estimate the economic burden of COVID-19 in hospitals affiliated with Jiroft University of Medical Sciences in southern Kerman, Iran.

The total direct medical costs for COVID-19 patients in this study amounted to \$600,211.89, with a mean cost of \$1333.80 ± 1315.02 per patient. Darab *et al.* (2021) conducted a study at a referral hospital for COVID-19 patients in Iran and found that the total costs and mean direct medical costs per patient were \$1,791,172 and \$3,755, respectively [13]. Bartsch *et al.* (2020) estimated the mean direct medical costs per COVID-19 patient in the US to be \$3045 [23]. Cleary *et al.* (2021) estimated the hospitalization cost for chronically ill patients in South Africa to be \$7600 [24]. Jin *et al.* (2020) found that the hospitalization cost for critically ill patients with COVID-19 in China was approximately \$9,000, with hospital beds being one of the largest cost components [25].

Kabir *et al.* (2021) conducted a study in a referral hospital for COVID-19 patients in Iran and reported that the mean direct medical cost for each chronically ill patient was \$5,117 [22]. Yusefi *et al.* (2022) estimated the

total direct medical costs of COVID-19 patients in a referral hospital in Iran to be \$1,037,992.15 [26]. Mojtabaeian and Monfared (2022) estimated the mean direct cost per COVID-19 patient in Iran to be 57,339,107 Rials [27].

It is important to note that direct medical costs can vary depending on factors such as the number of patients, disease severity, length of hospital stay, and length of ICU stay [28, 29]. The treatment costs for COVID-19 patients are generally higher than those for other infectious diseases, owing to the possibility of hospitalization and higher mortality rates [23]. The differences in total costs and mean direct medical costs across different studies may be attributed to differences in the range of medical diagnostic services, medications, and patient's insurance conditions.

The results indicated that pharmaceutical services accounted for the highest proportion of direct medical costs among the different types of services, amounting to 40.74% (\$244,578.16) of the total costs. Numerous studies have shown that medication expenses constitute the largest portion of direct medical costs [30, 31]. Darab *et al.* (2021) found that pharmaceutical costs accounted for 34% of the total cost for COVID-19 patients [13]. Similarly, Sadeghifar *et al.* (2021) reported that pharmaceutical services represented the largest portion (30%) of direct medical costs for COVID-19 patients [32]. Kabir *et al.* (2021) also identified drug costs as a major component (32%) of COVID-19 patient expenses [22]. In Yusefi *et al.*'s study (2022), the cost of medicines constituted the largest out-of-pocket expense for COVID-19 patients (50.23%) (26). Jin *et al.* (2020) found that medication costs constituted the largest proportion of the total costs for COVID-19 patients [25].

Another significant finding of this study was the relationship between the length of hospital stay and both the total direct cost and direct costs associated with different types of services. It was found that reducing the length of hospital stay could lead to various benefits, including increased revenue, cost reduction, decreased variations in clinical procedures, improved quality of care, and increased profitability. Prolonged and unnecessary hospital stays not only waste human resources and depreciate equipment but also result in additional costs for the patients.

Several studies have demonstrated that reducing the length of hospital stay can effectively lower costs without compromising health outcomes or the quality of care. As a result, policymakers, hospital managers, and third party payers (such as insurers) often prioritize strategies aimed at reducing hospital stays. These stakeholders emphasize the importance of containing hospital costs and maximizing efficient and effective utilization of limited hospital resources [33].

Another significant finding of the study was the statistically significant relationship between age, and the costs associated with various services such as visits, consultations, nursing services, CT scans, ECG,

ultrasound, MRI, ward equipment, and hoteling and bed. The results indicated that as age increased, the costs of these services also increased significantly ($p < 0.05$).

This finding is consistent with a study conducted by Richards *et al.* (2022), which found that, on average, older patients with COVID-19 incurred higher costs than younger age groups [11]. However, it is important to note that this finding contradicts the results of a study by Holy *et al.* (2020), which reported that older age groups (≥ 84 years) were associated with lower costs than other age groups [34]. The difference in findings between these studies may be attributed to insurance coverage for COVID-19 patients.

This study found a statistically significant relationship between insurance type, costs associated with visits, dialysis, and total direct costs ($p < 0.05$). According to Kabir *et al.* (2021), primary insurance covers an average of 82% of the total costs for COVID-19 patients [22]. Similarly, Sadeghifar *et al.* (2021) reported that primary insurance covered 80% of the total costs, whereas supplementary insurance covered 2% [32].

The study by Ghasvand *et al.* (2010) revealed that having supplementary insurance coverage at the 10% level was statistically significant in preventing the occurrence of financially burdensome medical costs. However, social health insurance plans in Iran have not been effective in reducing such costs. The ineffectiveness of social health insurance plans in supporting patients may be attributed to the design and implementation of insurance plans without considering important factors such as the socioeconomic status of households, demographic characteristics, and the pattern and epidemiology of diseases in Iran [35].

The COVID-19 pandemic not only resulted in direct costs but also imposed significant indirect costs. These indirect costs include potential reductions in productivity due to absenteeism during hospitalization and recovery and decreased productivity resulting from premature death. Additionally, income lost due to illness, obligatory stay-at-home measures, or death of the workforce due to COVID-19 can be considered indirect costs [13].

According to Kabir *et al.* (2021), the total mean indirect cost for each COVID-19 patient was estimated to be 959,577,714 Rials [22]. In a study by Darab *et al.* (2021), the reduction in productivity among COVID-19 patients was found to be twice as much as the direct medical costs per patient. The mean indirect cost per person in the above study was estimated to be \$11,634 [13]. Different indirect costs across different studies may be attributed to differences in the number of deaths among working-age individuals due to COVID-19.

The findings revealed that COVID-19 placed a significant economic burden on the study hospitals, amounting to \$4,186,389.48. Jin *et al.* (2021) conducted a study in China to examine the economic burden of COVID-19, reporting the total health costs and social costs associated with the disease as \$0.62 billion and \$383.02 billion US dollars, respectively [36]. Fusco *et al.* (2021)

conducted a study on the consequences and economic burden of 173,942 hospitalized patients with COVID-19 in the US, estimating the mean hospital costs to be \$12,046 [37]. Additionally, Lui *et al.* (2021) conducted a study in the US, which indicated that the economic burden of COVID-19, considering years of life lost due to illness, disability, and death, amounted to \$119.62 billion US dollars [38]. Bartsch *et al.* (2020) conducted a study in the US, estimating the mean direct medical costs per person during the pandemic to be \$3,045 [23]. Claxton *et al.* (2020) also conducted a study on the costs of COVID-19, reporting mean hospital costs of \$9,763 for patients without mechanical ventilation and \$34,223-88,114 for those requiring mechanical ventilation [39].

When comparing the study results with those of similar studies, it is evident that COVID-19 has imposed a substantial economic burden on various countries. This trend poses a significant challenge to healthcare systems, particularly in underdeveloped and low-income countries, potentially pushing them towards collapse [40]. Therefore, it is crucial to focus on managing and controlling new COVID-19 cases to prevent their spread.

Regarding the limitations of the study, it is important to note that due to the limited access to socioeconomic information of patients, further research is recommended to explore the impact of lost production and productivity across different income groups.

CONCLUSION

The investigation of the economic dimensions of COVID-19 in this study yielded substantial evidence supporting the implementation of socio-economic policies pertaining to COVID-19 and similar epidemics. The study findings, along with the estimated economic burden, indicate that COVID-19 has the potential to exert unprecedented economic pressure on the Iranian health system in terms of allocating financial resources to healthcare centers. Therefore, it is strongly recommended that disease control be prioritized through preventive measures and subsequently implemented cost control policies.

Also, the implementation of additional preventive measures, such as large scale vaccination in order to reduce the incidence and thus reduce direct and indirect medical costs is a vital issue that health managers and policy makers should consider.

AUTHORS' CONTRIBUTIONS

R.F.: Designed the study and prepared the initial draft; R.F. and A.R.Y.: Contributed to data collection and data analysis; S.B. and J.B.: Supervised the whole study and finalized the article.

LIST OF ABBREVIATIONS

ICU	=	Intensive Care Unit
HIS	=	Health Information System

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Jiroft University of Medical Sciences Ethics Committee, southern Iran with the ID number IR.JMU.REC.1400.048. All the methods were carried out in accordance with relevant guidelines and regulations.

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committees and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Not applicable.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

All the data is presented as a part of tables or figures. Additional data can be requested from the corresponding author [A.Y].

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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