

Geographical Distribution of COVID-19 Infection Across Saudi Arabia



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Abstract

Saudi Arabia, a large country in terms of population size and geographical area, administrative areas, and governorates, has metropolises, cities (large, medium-sized, and small), towns, and rural neighborhoods. COVID-19 epidemic of the millennium spread all over the country with differentials regarding infection (rates, percentages, and affected areas), besides day-to-day increases. This analysis of data compiled from COVID-19 daily reports published by the Saudi Ministry of Health considers administrative areas and localities (neighborhoods) to demonstrate the distribution of spread, increase of infection, and proportion of population infected over a period between 21 March 2020 and 4 May 2023. Many of the infected cases were reported in three major administrative areas, i.e., Riyadh, Makkah, and the Eastern Region; other regions had a smaller number of infected cases. On the other hand, some locations, especially medium-sized upcoming towns, and neighborhoods, had a greater number of persons seriously affected at a rapid pace with seasonal differentials. In addition, a varying number of infections and a wider geographical spread were observed. Such details of COVID-19 infection would be useful not only to develop combating strategies but also to create epidemic and emergency preparedness..

Keywords: Spread and Increase; Per 1000 Persons; Major Cities, Governorates and Localities; Seasonal Variations

Introduction

Saudi Arabia is a large country in terms of geographical area and is divided into 13 administrative areas and 151 governorates. The country borders five Arabian Gulf countries and a few other Arab nations, boasting a wide coastal area to the east and west. Despite accommodating a vast population, both native and foreign, the country maintains a low population density, mainly because of uninhabited desert areas. Developmental efforts focused on constructing infrastructure -residential, commercial, educational, and medical- in various parts of the country have created many urban areas. Consequently, populations have migrated to these areas seeking improved lifestyles, livelihoods, and professional opportunities [1]. In summary, many cities and towns in Saudi Arabia have high population concentrations. This situation expedites the potential for faster infection rates in the country [2-5]. Saudi Arabia has grappled with a rapid spread of COVID-19 in various overpopulated areas characterized by a transient population, despite efforts to contain, isolate, enforce social distancing, and impose lockdowns.

In addition, the country implemented several strategies, such as the suspension of religious, entertainment, and sporting mass gatherings; temporary closure of educational establishments; and the postponement of all non-essential gatherings by imposing a complete curfew - implemented even before confirming the first case [6-11]. COVID-19, recognized as a new strain of the Middle East Respiratory Syndrome Coronavirus, plagued the Middle East, with many cases reported in Saudi Arabia. The country also experienced a higher case fatality rate [12]. The global pandemic reported its first case on March 2, 2020, in Saudi Arabia and has been resisted through various strategic interventions. Saudi Arabia has been appraised for its mitigation measures (a combination of Chinese and German technologies) characterized by swift community action and hospital preparedness. These efforts have been made in the absence of experimental studies on treatment options, economic impact assessments, and epidemiological studies [13-17]. This endeavor could be aligned with the 2030 Vision, which aims to position the country as a business and tourism hub, aiming for well-developed herd immunity [18,24].

Considering the diverse geography of the country and the heterogeneity of its population in terms of living arrangements, population density, and livelihoods reflected in varying sex ratios, child population, geographical condition, environmental situation, and the availability of resources, such as hospitals and medical facilities. This study aimed to conduct a spatial analysis of COVID-19. Hence, disparities across cities and neighborhoods, in addition to the administrative areas of the country, were important in understanding risk factors, immune responses, treatment effectiveness, and mortality rate. This spatial analysis, focused on administrative areas, aimed to comprehend the spread and escalation of the epidemic, in addition to highlighting the distribution of the infected population with a special emphasis on geographical spread and seasonal variations.

Methods

This analysis was based solely on daily reports of COVID-19 cases published by the Ministry of Health of Saudi Arabia (<https://sehhty.com>), which is referred to by as the most reliable source of information. Reports from March 21, 2020, to May 4, 2023, were compiled on an Excel worksheet for consolidated illustrations and analyses.

1.1. A trend of daily infections across administrative areas was plotted.

1.2. Majorly affected locations within each administrative area were plotted.

1.3. An increase in infection rates was calculated for each administrative area, specifically focusing on the major affected locations.

1.4. The number of infected cases per 1000 individuals based on available population data in 2020, 2021, and 2022 for administrative areas was determined.

Population sizes for administrative areas in 2020, 2021, and 2022 were used to calculate the infection rate per 1000 individuals. However, population data for localities within each administrative area was only available for 2022.

Results

Saudi Arabia has been substantially impacted by COVID-19 (MERS-COV 2). The infection initially spread through travelers from Iran to the Eastern Region via neighboring Bahrain and Kuwait. A few cases in Al-Qatif City disseminated to other parts of the province and thereafter extended to additional provinces and neighborhoods, such as Makkah, Jeddah, Al-Madina, and Riyadh. On March 21, 2020, the Ministry of Health commenced daily online data uploads, recording a total of 392 infected individuals. The infection rate swiftly escalated to 1,453 by March 31, 2020, and reached 840,435 by May 4, 2023. This indicates a rapid spread, especially during June-July 2020, reporting approximately 5,000 new cases per day, and later during January-February 2022. The spread during June-July is referred to as the first wave, while that

during January-February is referred to as the second wave, with random surges in the second quarter of 2021.

Spread in the Administrative Areas

Several governorates in Saudi Arabia were affected with varying intensities. Metropolises with a large transient population, emerging cities with a dense population, and areas with a high proportion of expatriates, were more affected than others. For example, by May 4, 2023, Riyadh, Makkah, and the Eastern Region administrative areas were affected more than the others with 231,547, 206,004, and 164,006 affected individuals, respectively, accounting for approximately 71% of the total cases. Al-Jouf and the Northern Borders had 3,974 and 7,038 infected individuals, respectively, marking the two administrative areas with the lowest infection rates. Another region exhibiting lower spread was Al-Baha, with 11,143 reported cases (Figure 1).

Affected Locations in Each Administrative Area

Certain governorates and cities, recognized as major commercial, educational, residential, and developmental zones hosting migrants, reported a higher number of cases. Illustrates these geographical clusters by percentage for each quarter annually. For example, in the Riyadh administrative area, Al-Kharj, Riyadh, and Wadi Ad Dawasir emerged as major affected areas: key economic, commercial, and educational centers. These locations exhibited higher infection rates, but with seasonal variations. The overall infection rate displayed peak periods in the second quarter (Q2 2020; April-June) and Q1 2022 (January-March). Riyadh City recorded peak infections in Q1 2022, followed by Q2 2020. Al-Kharj had the highest infection rate in Q1 2022, followed by Q2 2020 and Q3 2020. Wadi Ad Dawasir followed a different trend, with its highest infection rate in Q3 2020, followed by Q2 2021.

The overall infection rate in this administrative area largely depended on Riyadh City. In contrast, the Makkah administrative area had high infection rates in Jeddah, Makkah City, and Taif. Makkah City experienced a substantial surge during Q2 2020, followed by Q1 2022, and Q3 2020. Jeddah showed a different pattern, with its highest infection rate was in Q2 2020 and Q1 2022, while Taif recorded peak infections during Q2 2020 and Q3 2020. Other locations in this region recorded elevated infection rates in Q1 2022. In contrast, the Al-Madina administrative area experienced a gradual spread: Al-Madina City showed substantial spread during Q2 2020; Al-Ula initially had a lower spread but reached its highest during Q1 2022; and Yanbu had a gradual spread, with the highest in Q3 2020 and Q3 2021.

The three majorly affected localities in the Eastern Region were Ad Dammam, Al-Hufuf, and Al-Khubar, with heavy infections occurring during Q2 2020 (very high in Al-Khubar) and Q1 2022. Al-Qasim showed a different pattern: Q2 2020 was less serious, but Q3 had a wider spread, especially in Buraydah and its smaller localities. Q1 2022 also recorded higher levels, particularly in Ar Rass, whereas Unayzah recorded a smaller spread. Hail administrative areas recorded heavy infections in Ash Shinan,

Baqa, and Hail City. None exhibited high levels in Q2 2020, but Ash Shinan reported high levels in Q2 2021, while Baqa and Hail City experienced elevated infections in Q3 2020. Additionally, smaller geographic clusters indicated significant infection rates in Q3 2020, Q2 2021, Q3 2021, and Q1 2022. Aseer had a more limited spread, except in Q3 2020 in Khamis Mushayt, Muhayil, and other smaller

locations. However, Q1 2022 saw a serious spread in Muhayil and Abha, but not in Khamis Mushayt. In the Jazan administrative area, a comparatively uniform spread was recorded in Abu Arish, Baysh, Jazan City, and other smaller locations, with high infection rates during Q3 2020 and Q1 2022. Baysh experienced serious infections only in Q2 2020.



Figure 1: Daily COVID-19 Infections in Saudi Arabia and Its 13 Administrative Areas.

Hubuna, Najran City, and Sharorah were the most affected localities in the Najran administrative area. None of them had a high spread during Q2 2020. Hubuna recorded a high spread in Q2 2021 and Q3 2021, and Najran City and Sharorah recorded a high spread in Q3 2020. Other smaller geographic divisions/townships recorded a gradual spread. In the Northern Borders administrative area, Arar, Rafha, Turayf, and other smaller townships recorded a spread. Arar experienced high spread during Q3 2020, Q2 2021, and Q1 2022; Rafha followed a similar pattern but in Q3 2021 instead of Q2 2021; Turayf showed high spread during Q1 2021 and Q1 2022. In the Al-Jouf administrative area, Al-Qurayyat, Sakaka, Tubarjal, and other smaller townships were affected. The highest spread occurred during Q3 2020 and Q1 2022 in Al-Qurayyat and Sakaka, Q3 2021 and Q2 2022 in Tubarjal, and Q1

2022 in other smaller units. In the Al-Baha administrative area, Al-Baha City experienced serious impact in Q1 2022, Al-Mukhwah in Q3 2020 and Q1 2022, and Biljurashi in Q3 2020 and Q2 2021. Other smaller locations exhibited the widest spread during Q3 2020 and Q1 2022. Within the Tabouk administrative area, Duba (Q1 2022), Tabouk City (Q3 2020), and Umluj (Q2 2021 and Q3 2021) were the most affected areas, showing seasonal variations. Other smaller locations in the area experienced major infections in Q1 2022 (Figure 2). The number of locations affected in each administrative area varied: Riyadh (33), Makkah (29), Al-Madina (11), the Eastern Region (27), Al-Qasim (14), Hail (9), Aseer (25), Jazan (17), Najran (7), the Northern Borders (8), Al-Jouf (8), Al-Baha (9), and Tabouk (8), constituting a total of 205 localities.

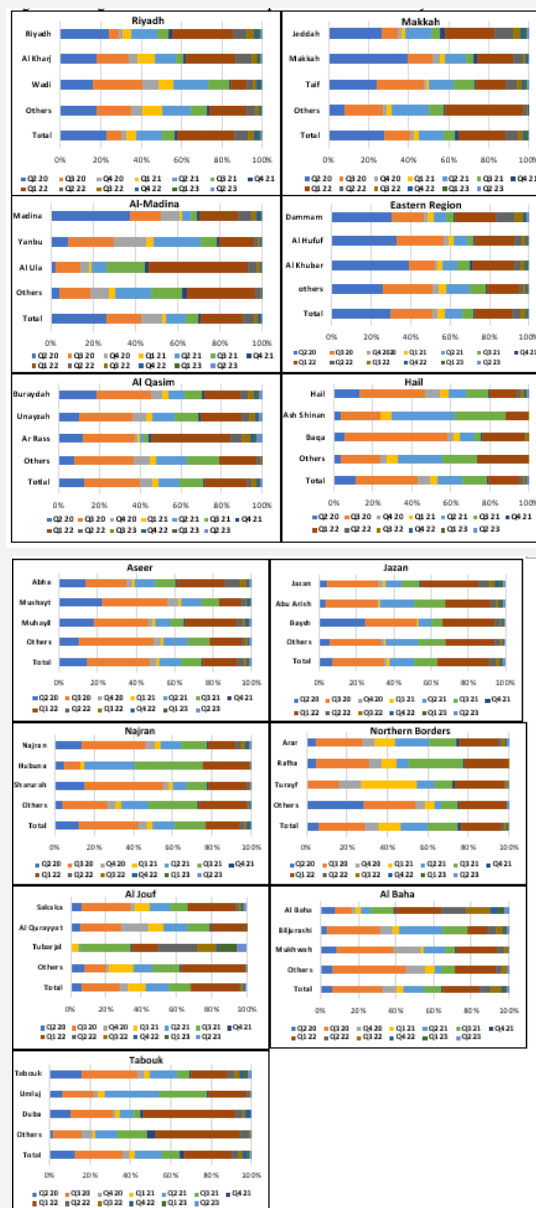


Figure 2: Percentage Distribution of COVID-19 Spread at Various Locations by Administrative Areas.

Increase in Infection

This section aims to explain the pattern of COVID-19 spread, highlighting the major affected localities. It was found that cases of infection increased significantly, from a mere 392 cases on March 21 (193,899 in Q2 2020, including 10 days in March) to 847,219 in Q2 2023 (April and 4 days in May). This represented 4.4 times increase with seasonal, monthly, and quarterly variations. This increase on a daily basis was traced across quarters-seasons: cases increased by 1.7 (334,690), 1.9 (362,652), 2.0 (390,325), 2.5 (488,499), 2.8 (546,599), 2.9 (556,868), 3.9 (750,564), 4.1 (795,593), 4.2 (816,373), 4.3 (826,686), and 4.3 (833,527) times, quarter-wise, recording the highest increases during Q1 2022 (1.0 points from 2.9 to 3.9), followed by Q2 2021 (0.5 points from 2.0 to 2.5), and recording a fractional increase except in Q3 2021 (0.3 point increase). The Riyadh administrative area, housing the national capital, initially recorded 52,909 cases (Q2 2020), which saw a gradual increase until Q1 2021, followed by a rise of 0.6 points.

Subsequently, in Q1 2022, it surged by 1.3 points, displaying a slow but consistent upward trend. By Q2 2023, this administrative area reported a total of 231,547 cases. Numerous localities within this area were affected, notably Ad Duwadimi (77–2,079; 27 times), Ad Dilam (956–5,387; 19.2 times), and Afif (1,371–1,979; 17.0 times). While these increases followed a different pattern, Ad Duwadimi witnessed the fastest rise, particularly during Q1 2022 (an increase from 1,705 to 1,880; 175 cases) and Q2 2021 (from 1,572 to 1,656; 84 cases). However, the number of cases in Ad Dilam rapidly increased during Q1 2021 and Q2 2021 (from 2,040 to 2,528, an increase of 488; and to 3,072, an increase of 544), marking rises of 4.5 and 4.4 points, respectively. In Afif, the increase was less rapid (from 1,371 to 1,979 cases), with the most rapid rise observed during Q2 2021 (from 1,572 to 1,656 cases), marking an increase of 3.4 points. All other localities, including Riyadh, recorded nominal increases except during Q1 2021 and Q2 2021.

In the Makkah administrative area, there were 57,389 cases in Q2 2020, which increased rapidly in the next quarter (0.5 points) and thereafter progressed slowly until Q1 2021. It saw a rise of 0.5 points in Q1 2021 and 0.9 points in Q1 2022, with a gradual but consistent increase to 206,004 by Q2 2023. The majorly affected localities include Al-Kamil (31–1768; 57 times), Al-Lith (100–3869; 38.7 times), and Rabigh (5537–23032; 18.8 times). While these increases showed different patterns, Al-Kamil's rise was considered the fastest, particularly during Q3 2020 (an increase from 31 to 261; 230 cases), Q2 2021, and Q3 2021 (362–840, an increase of 478 cases, and to 1,170 cases, an increase of 330 cases, respectively), and Q1 2022 (1,180–1,741; 561 cases). In contrast, cases in Rabigh recorded rapid increases only in Q1 2022 (16,956–20,408; 3,452 cases), registering a 13.9-point surge. All other localities, including Jeddah and Makkah, recorded nominal increases, except in Q1 2022, although Makkah and Al-Qunfudhah did not.

In the Al-Madina administrative area, there were 15,106 cases in the beginning quarter (Q2 2020), which increased quickly over the next two quarters (0.6 and 0.4 points), and thereafter proceeded slowly until Q4 2021, raised by 0.7 points. In Q1 2022, it is reporting slow but steady increases, reaching 56,872 by Q2 2023. Localities notably affected at a rapid pace include Al-Ula (35–1,699; 48.5 times), Khaybar (24–1,384; 57.7 times), Al-Mahd (95–1,125; 11.8 times), and Yanbu (947–11,305; 11.9 times). While these increases showed different patterns, Khaybar witnessed the fastest rise. Initially low in Q2 2020, it surged notably in Q3 2020 and Q4 2020 (from 24 to 275, an increase of 251 cases; and to 398, an increase of 123 cases, respectively), followed by Q2 2021 and Q3 2021 (from 434 to 640, an increase of 206 cases; and to 850, an increase of 210 cases, respectively), and Q1 2022 (from 852 to 1,339, an increase of 487 cases). However, the number of cases at Al-Mahd (most rapid in Q1 2022) and Yanbu increased slowly (from 95 to 1,125 and from 947 to 11,305, respectively). Al-Madina recorded a gradual increase, whereas other localities experienced swift spreading, especially in Q2 2021 and Q1 2022.

In the Al-Qasim administrative area, there were 3,759 cases in the first quarter, which rapidly increased in the next quarter (2.2 points) and continued to rise in Q1 2021 and Q2 2021 (0.9 points each) and Q1 2022 (1.7 points), reporting slow but steady increases. This number reached 29,347 by Q2 2023. Affected localities included Al-Badai (98–1,507; 15.4 times), Al-Midhnab (161–1,801; 11.2 times), Riyadh Al-Khabra (77–1,489; 19.3 times), and others (507–5,904; 11.6 times). Although these increases followed different patterns, neither Al-Badai nor Al-Midhnab showed rapid seasonal increases, while Riyadh Al-Khabra did experience such rises in Q3 2021 and Q1 2022. While Buraydah recorded a slow increase, other localities witnessed a rapid spread, especially in Q1 2022.

In the Eastern Region, where this epidemic first emerged in the country, there were 48,305 cases initially. It swiftly spread, expanding to a large population in the next quarter (83,999 with a gap of 35,694, resulting in 0.7 points increase), followed by another rise in Q1 2022 (0.6 points). A gradual but consistent increase was reported, reaching 164,006 by Q2 2023. Localities substantially and rapidly affected included Al-Khafji (208–3,456; 16.6 times) and Al-Mubarraz (2,728–13,068; 4.8 times). Despite following a similar pattern, a rapid increase was recorded during Q2 2021 and Al-Khafji had a second season of rapid increase during Q3 2021 (3.9 and 3.8 points, respectively). Major cities, such as Ad Dammam, Al-Khubar, and Al-Jubayl, recorded slow increases. The Aseer administrative area initially recorded a reasonably high spread of 7,972 in Q2 2020, which gradually increased to 55,573 by Q2 2023. The widely affected localities were Ballasmar (86–2,999; 34.9 times), Zahran Al-Janub (102–1,740; 17.1 times), Rijal Al-Ma (91–1,751; 19.2 times), and Sarat Abidah (102–1,934; 19.0 times). While these increases followed different patterns, Ballasmar's and Rijal Al-Ma's increases were comparable to those of Zahran Al-Janub and Sarat Abidah. The Tabouk administrative area was a less affected geographical area, with a smaller spread of 1,537

cases in Q2 2020, which slowly increased to 12,751 by Q2 2023. Localities in this administrative area were less widely affected, except Tabouk (1,338–8,568; 6.4 times). While the increase was slow, there was a relatively high spread during Q2 2020. Other localities in the area had a relatively low spread in the first quarter, notably expanding from 199 to 4,183, marking a 21-time increase.

Similarly, the Hail administrative area followed a comparable pattern, recording a smaller spread of 1,615 cases in Q2 2020, which gradually increased to 143,949 by May 4, 2023. Localities in this administrative area were less widely affected, except for Hail (1,484–11,293; 7.6 times). While this increase was slow, there was a relatively high spread in Q2 2020, which recorded a slow but steady increase. Other localities witnessed a low spread in the first quarter but a rapid spread in the next one (Q3 2020), and thereafter in Q2 2021, Q3 2021, and Q1 2022. This was relatively widespread. The Northern Borders administrative area followed a pattern very similar to that of Tabouk and Hail areas, recording a smaller spread: 431 cases in Q2 2020, which increased slowly to 7,038 by Q2 2023. Localities in this administrative area were less widely affected except the headquarters Arar (208–4,422; 21.3 times) and Rafha (57–1201; 21.1 times), where the initial slow spread expanded in Q3 2020, Q2/Q3 2021, and Q1 2022. Other localities in the area witnessed a low spread in the first quarter that was maintained throughout by containment measures.

Jazan had a different pattern of spread, and most of the major locations were widely affected: 2,393 cases in Q2 2020 increased rapidly to 33,286 by Q2 2023, marking Q3 2020 (to 11,651; 4.9 points) and Q1 2022 (from 21,188 to 30,318; 3.8 points) as the rapid increase seasons. Widely affected localities in this administrative area were the headquarters Jazan (437–10,399; 23.8 points) and others, such as Abu Arish (142–4,674; 32.9 points), Baysh (1,056–4,364; 4.9 points), Sabya (232–3,268; 14.1 points), and Samtah (155–2,324; 15.0 points). Out of these, the largest city/governorate, Jazan, had the smallest spread, with a rapid spread at two points, in Q3 2020 (to 3294; 7.5 points) and Q1

2022 (from 5695 to 8858; 7.0 points), whereas the other specified towns had different patterns. The rest of Jazan, comprising small towns, witnessed a rapid and wide increase in COVID-19, by 22.3 times, with Q3 2020, Q2 2021, and Q1 2022 as the seasons of rapid increase.

The Najran administrative area had a lesser spread, unlike Jazan: 1,651 cases in Q2 2020 increased slowly to 13,957 by Q2 2023, indicating no sharp increase or seasonal spread. Najran (1,208–8,799; 7.3 times) and Sharorah (329–2,231; 6.8 times) were the two widely affected localities, with no widespread, not even seasonal variations. The rest of Najran, comprising small towns and neighborhoods, recorded a rapid spread from a mere 114 to 2,927 cases, increasing by 25.7 times. A smaller administrative area, Al-Baha, had a smaller spread: 684 cases in Q2 2020 increased slowly to 11,143 by Q2 2023, marking an increase in Q3 2020. The three major towns/governorates having high spread included Al-Baha (244–3,066; 12.6 times), Al-Mukhwah (118–1,369; 11.6 times), and Biljurashi (103–3097; 30.1 times). Out of these, Biljurashi Town's spread could be considered wider than the other two, whereas the headquarters had a smaller spread. In addition, there were no periodic (seasonal) increases noted in Al-Baha and Al-Mukhwah, but there were seasonal increases noted in Biljurashi (Q3 2020, Q2 2021 and Q3 2021, and Q1 2022). The remaining Al-Baha recorded a rapid increase from 219 to 3,611 cases, indicating an increase of 16.5 times.

Another smaller administrative area was Al-Jouf, which had a comparatively smaller spread: 248 cases in Q2 2020, which increased to 35,318 by Q2 2023, marking an increase in Q3 2020 (to 1,350; 4.4 times) and Q1 2022 (11,935–15,738; 4.4 times). The only major town with a high spread was Sakaka, the headquarters (117–1,952; 16.7 times) with the same seasonal hikes of Q3 2020 (to 656; 5.6 times) and Q1 2022 (1,300–1,819; 3.4 times). The rest of Al-Jouf recorded an almost equal spread, from a mere 131 to 2,022 cases, increasing by 15.4 times (Table 1).

Table 1: The Increase in COVID-19 Reported Cases from the base by Administrative Areas.

| Region/Location | 2020 | | | 2021 | | | | 2022 | | | | 2023 | |
|-------------------|------|-----|-----|------|------|------|------|------|------|------|------|------|------|
| | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 |
| Riyadh | | | | | | | | | | | | | |
| Ad Diriyah | 1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| Afif | 1 | 4.8 | 5.8 | 6.7 | 10.1 | 12.3 | 12.4 | 15.2 | 16 | 16.4 | 16.8 | 16.8 | 17 |
| Ad Duwadimi | 1 | 5.5 | 6.5 | 8.3 | 12.8 | 14.5 | 14.8 | 22.4 | 24.2 | 25.2 | 25.8 | 26.3 | 27 |
| Ad Dilam | 1 | 3.1 | 4.7 | 9.2 | 13.6 | 15 | 15 | 18.2 | 18.8 | 18.9 | 19.1 | 19.1 | 19.2 |
| Al-Kharj | 1 | 1.9 | 2.1 | 2.6 | 3.2 | 3.4 | 3.5 | 4.9 | 5.3 | 5.5 | 5.5 | 5.6 | 5.6 |
| Al-Majmaah | 1 | 2.3 | 3.3 | 4 | 5 | 5.5 | 5.6 | 6.8 | 7 | 7.1 | 7.2 | 7.2 | 7.2 |
| Hawtat Bani Tamim | 1 | 2.3 | 2.6 | 3.4 | 4.7 | 5.1 | 5.1 | 6.2 | 6.5 | 6.6 | 6.6 | 6.6 | 6.6 |
| Riyadh City | 1 | 1.2 | 1.3 | 1.5 | 2 | 2.2 | 2.3 | 3.6 | 3.9 | 4 | 4.1 | 4.1 | 4.2 |
| Wadi Ad Dawasir | 1 | 2.5 | 3 | 3.5 | 4.5 | 5.2 | 5.2 | 5.7 | 5.9 | 6 | 6.1 | 6.2 | 6.2 |
| Rest of Riyadh | 1 | 2.2 | 2.5 | 3.1 | 3.8 | 4.4 | 4.5 | 5.7 | 5.9 | 6 | 6.1 | 6.1 | 6.1 |

| | | | | | | | | | | | | | |
|------------------------|---|------|------|------|------|------|------|------|------|------|------|------|------|
| Total | 1 | 1.3 | 1.4 | 1.6 | 2.2 | 2.5 | 2.5 | 3.8 | 4.1 | 4.2 | 4.3 | 4.3 | 4.4 |
| Makkah | | | | | | | | | | | | | |
| Al-Kamil | 1 | 8.4 | 10.4 | 11.7 | 27.1 | 37.7 | 38.1 | 56.2 | 57 | 57 | 57 | 57 | 57 |
| Al-Lith | 1 | 6.2 | 6.8 | 9 | 21.2 | 23.3 | 23.6 | 38.3 | 38.6 | 38.7 | 38.7 | 38.7 | 38.7 |
| Jeddah | 1 | 1.3 | 1.4 | 1.5 | 1.9 | 2.1 | 2.2 | 3.2 | 3.5 | 3.6 | 3.7 | 3.8 | 3.8 |
| Khulays | 1 | 2.6 | 2.9 | 3 | 3.5 | 3.6 | 3.7 | 8.6 | 8.7 | 8.7 | 8.7 | 8.7 | 8.7 |
| Makkah City | 1 | 1.3 | 1.4 | 1.5 | 1.7 | 1.8 | 1.9 | 2.3 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Al-Qunfudhah | 1 | 4.4 | 4.7 | 5 | 7.2 | 8.3 | 8.4 | 9.7 | 9.9 | 9.9 | 10 | 10 | 10 |
| Rabigh | 1 | 2 | 2 | 2.2 | 3 | 3.6 | 4 | 18.1 | 18.7 | 18.8 | 18.8 | 18.8 | 18.8 |
| Taif | 1 | 2 | 2 | 2.1 | 2.6 | 3 | 3.1 | 3.7 | 3.9 | 4 | 4.1 | 4.1 | 4.2 |
| Rest of Makkah | 1 | 3 | 3.3 | 3.5 | 5.2 | 6 | 6.1 | 9 | 9.3 | 9.4 | 9.4 | 9.4 | 9.4 |
| Total | 1 | 1.5 | 1.5 | 1.6 | 2.1 | 2.3 | 2.3 | 3.2 | 3.4 | 3.5 | 3.5 | 3.6 | 3.6 |
| Al-Madina | | | | | | | | | | | | | |
| Al-Ula | 1 | 6.9 | 8.7 | 9.3 | 12.7 | 21.6 | 22.4 | 45.1 | 47.1 | 48 | 48.3 | 48.4 | 48.5 |
| Khaybar | 1 | 11.5 | 16.6 | 18.1 | 26.7 | 35.4 | 35.5 | 55.8 | 57.2 | 57.5 | 57.6 | 57.6 | 57.7 |
| Al-Mahd | 1 | 3.9 | 5.2 | 5.9 | 6.7 | 7 | 7.2 | 11.6 | 11.7 | 11.8 | 11.8 | 11.8 | 11.8 |
| Yanbu | 1 | 3.6 | 5.4 | 5.8 | 8.4 | 9.4 | 9.5 | 11.5 | 11.7 | 11.8 | 11.9 | 11.9 | 11.9 |
| Al-Madina City | 1 | 1.4 | 1.6 | 1.7 | 1.8 | 1.9 | 1.9 | 2.4 | 2.5 | 2.6 | 2.7 | 2.7 | 2.7 |
| Rest of Al-Madina | 1 | 3.9 | 6.2 | 6.7 | 12.5 | 17.4 | 18.4 | 26.6 | 27.2 | 27.6 | 27.7 | 27.7 | 27.7 |
| Total | 1 | 1.6 | 2 | 2 | 2.4 | 2.6 | 2.7 | 3.4 | 3.6 | 3.7 | 3.7 | 3.7 | 3.8 |
| Al-Qasim | | | | | | | | | | | | | |
| Al-Badai | 1 | 5 | 5.9 | 6.3 | 8.4 | 11.1 | 11.2 | 14.9 | 15.2 | 15.3 | 15.3 | 15.3 | 15.4 |
| Al-Midhnab | 1 | 5 | 5.9 | 6.3 | 7.5 | 9.2 | 9.2 | 11 | 11.1 | 11.1 | 11.1 | 11.1 | 11.2 |
| Ar Rass | 1 | 3.2 | 3.3 | 3.4 | 3.6 | 3.8 | 3.9 | 7.2 | 7.6 | 8 | 8.2 | 8.3 | 8.5 |
| Buraydah | 1 | 2.5 | 2.8 | 2.9 | 3.3 | 3.8 | 3.9 | 4.8 | 5 | 5.2 | 5.3 | 5.3 | 5.4 |
| Riyadh Al-Khabra | 1 | 6.5 | 8.5 | 8.9 | 12.3 | 15.6 | 15.7 | 19.3 | 19.3 | 19.3 | 19.3 | 19.3 | 19.3 |
| Unayzah | 1 | 3.6 | 4.2 | 4.5 | 5.6 | 6.8 | 6.9 | 8.8 | 9.2 | 9.5 | 9.6 | 9.7 | 9.9 |
| Rest of Al-Qasim | 1 | 4.3 | 5.3 | 5.7 | 7.5 | 9.3 | 9.4 | 11.3 | 11.5 | 11.6 | 11.6 | 11.6 | 11.6 |
| Total | 1 | 3.2 | 3.7 | 3.9 | 4.8 | 5.7 | 5.7 | 7.4 | 7.6 | 7.8 | 7.8 | 7.9 | 8 |
| Eastern Region | | | | | | | | | | | | | |
| Al-Jubayl | 1 | 1.3 | 1.4 | 1.5 | 1.7 | 2 | 2 | 2.4 | 2.4 | 2.5 | 2.5 | 2.5 | 2.5 |
| Al-Khafji | 1 | 3.5 | 4.1 | 5.2 | 9.1 | 12.1 | 12.2 | 15.7 | 16.1 | 16.3 | 16.4 | 16.5 | 16.6 |
| Al-Mubarraz | 1 | 2.9 | 3 | 3.2 | 3.8 | 4.1 | 4.1 | 4.7 | 4.7 | 4.8 | 4.8 | 4.8 | 4.8 |
| Al-Nuayriyah | 1 | 4 | 4.8 | 5.2 | 9 | 10.4 | 10.4 | 12.1 | 12.2 | 12.2 | 12.2 | 12.2 | 12.2 |
| Buqayq | 1 | 2.8 | 3 | 3.6 | 4.7 | 5.3 | 5.3 | 6.1 | 6.2 | 6.2 | 6.2 | 6.2 | 6.2 |
| Ad Dammam | 1 | 1.5 | 1.6 | 1.7 | 1.9 | 2 | 2.1 | 2.7 | 3.1 | 3.2 | 3.2 | 3.3 | 3.3 |
| ADh Dhahran | 1 | 1.8 | 2 | 2.2 | 2.7 | 3.1 | 3.1 | 3.8 | 4.1 | 4.3 | 4.3 | 4.4 | 4.5 |
| Hafar Al-Batin | 1 | 3.5 | 3.6 | 3.6 | 4 | 4.6 | 4.6 | 5.7 | 5.7 | 5.8 | 5.8 | 5.8 | 5.9 |
| Al-Hufuf | 1 | 1.7 | 1.8 | 1.9 | 2.1 | 2.2 | 2.2 | 2.8 | 3 | 3 | 3 | 3 | 3.1 |
| Al-Khubar | 1 | 1.3 | 1.4 | 1.4 | 1.6 | 1.8 | 1.8 | 2.4 | 2.5 | 2.5 | 2.5 | 2.6 | 2.6 |
| Al-Qatif | 1 | 1.5 | 1.6 | 1.7 | 1.7 | 1.8 | 1.9 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.4 |
| Ras Tannurah | 1 | 1.9 | 2 | 2.1 | 2.2 | 2.4 | 2.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 |
| Safwa | 1 | 1.5 | 1.5 | 1.5 | 1.7 | 1.9 | 1.9 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| Rest of Eastern Region | 1 | 2.7 | 3 | 3.4 | 4.6 | 5.4 | 5.4 | 6.9 | 7 | 7 | 7.1 | 7.1 | 7.1 |
| Total | 1 | 1.7 | 1.8 | 1.9 | 2.2 | 2.4 | 2.5 | 3.1 | 3.3 | 3.3 | 3.4 | 3.4 | 3.4 |
| Aseer | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|--------------------------|---|------|------|------|------|------|------|------|------|------|------|------|------|
| Abha | 1 | 2.6 | 2.8 | 2.9 | 3.6 | 4.5 | 4.5 | 6.3 | 6.9 | 7.1 | 7.2 | 7.3 | 7.3 |
| Ahad Rufaydah | 1 | 3.3 | 3.5 | 3.5 | 3.9 | 4.3 | 4.3 | 5.6 | 5.8 | 5.8 | 5.9 | 5.9 | 6 |
| Ballasmar | 1 | 10.5 | 13.3 | 14 | 21.7 | 31.2 | 31.3 | 33.5 | 34.1 | 34.7 | 34.7 | 34.7 | 34.9 |
| Bishah | 1 | 2.5 | 2.6 | 2.7 | 3.3 | 3.7 | 3.7 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.6 |
| Zahrn Al-Janub | 1 | 5.5 | 6.6 | 7 | 11.5 | 13.8 | 13.9 | 16.5 | 16.8 | 16.9 | 16.9 | 17 | 17.1 |
| Khamis Mushayt | 1 | 2.6 | 2.8 | 2.9 | 3.4 | 3.8 | 3.8 | 4.3 | 4.4 | 4.4 | 4.5 | 4.5 | 4.5 |
| Muhayil | 1 | 2.5 | 2.7 | 2.7 | 3.2 | 3.6 | 3.6 | 5.1 | 5.3 | 5.3 | 5.4 | 5.4 | 5.5 |
| Rijal Al-Ma | 1 | 8.5 | 10 | 10.2 | 12.7 | 15.4 | 15.5 | 18.9 | 19.1 | 19.2 | 19.2 | 19.2 | 19.2 |
| Sarat Abidah | 1 | 6.2 | 6.9 | 7 | 7.4 | 7.6 | 7.6 | 15.3 | 16.3 | 16.9 | 17.5 | 18.2 | 19 |
| Rest of Aseer | 1 | 5.5 | 5.7 | 5.8 | 6.9 | 7.8 | 7.8 | 9.3 | 9.4 | 9.5 | 9.5 | 9.5 | 9.5 |
| Total | 1 | 3.3 | 3.5 | 3.6 | 4.4 | 5.2 | 5.2 | 6.5 | 6.7 | 6.8 | 6.9 | 6.9 | 7 |
| Tabouk | | | | | | | | | | | | | |
| Tabouk City | 1 | 2.8 | 3 | 3.2 | 4 | 4.4 | 4.5 | 5.7 | 5.9 | 6 | 6.2 | 6.3 | 6.4 |
| Rest of Tabouk | 1 | 4.4 | 5.1 | 5.5 | 8.7 | 11.8 | 12.3 | 19.9 | 20.6 | 20.8 | 20.9 | 20.9 | 21 |
| Total | 1 | 3 | 3.3 | 3.5 | 4.6 | 5.4 | 5.5 | 7.5 | 7.8 | 7.9 | 8.1 | 8.2 | 8.3 |
| Hail | | | | | | | | | | | | | |
| Hail City | 1 | 2.6 | 4.2 | 4.5 | 4.8 | 6 | 6.1 | 7.1 | 7.3 | 7.4 | 7.5 | 7.5 | 7.6 |
| Rest of Hail | 1 | 6.9 | 8.8 | 10.1 | 14.9 | 20.9 | 21 | 27.2 | 27.3 | 27.4 | 27.4 | 27.4 | 27.4 |
| Total | 1 | 2.9 | 4.5 | 4.9 | 5.7 | 7.2 | 7.3 | 8.8 | 8.9 | 9.1 | 9.1 | 9.1 | 9.2 |
| Northern Borders | | | | | | | | | | | | | |
| Arar | 1 | 5.8 | 7.2 | 9.3 | 12.9 | 15.8 | 16.1 | 20.1 | 20.5 | 21 | 21 | 21.1 | 21.3 |
| Rafha | 1 | 6.5 | 7.8 | 9.4 | 10.6 | 16.3 | 16.5 | 20.9 | 21 | 21.1 | 21.1 | 21.1 | 21.1 |
| Rest of Northern Borders | 1 | 2.6 | 3.3 | 4.9 | 5.5 | 6.2 | 6.3 | 8.4 | 8.4 | 8.5 | 8.5 | 8.5 | 8.5 |
| Total | 1 | 4.7 | 5.8 | 7.6 | 9.7 | 12.2 | 12.4 | 15.7 | 15.9 | 16.2 | 16.2 | 16.2 | 16.3 |
| Jazan | | | | | | | | | | | | | |
| Abu Arish | 1 | 10.2 | 10.4 | 10.8 | 16.8 | 22.3 | 22.4 | 30.2 | 31.3 | 31.7 | 32 | 32.4 | 32.9 |
| Baysh | 1 | 2.2 | 2.2 | 2.2 | 2.5 | 2.7 | 2.7 | 3.9 | 4 | 4 | 4.1 | 4.1 | 4.1 |
| Jazan City | 1 | 7.5 | 8.2 | 8.4 | 10.5 | 12.8 | 13 | 20.3 | 21.6 | 22.4 | 22.9 | 23.4 | 23.8 |
| Sabya | 1 | 5.3 | 5.4 | 5.5 | 7.2 | 8.3 | 8.4 | 13 | 13.8 | 14 | 14 | 14 | 14.1 |
| Samtah | 1 | 6.5 | 6.6 | 6.8 | 8.5 | 9.8 | 9.9 | 13.6 | 14.1 | 14.4 | 14.6 | 14.7 | 15 |
| Rest of Jazan | 1 | 6.5 | 6.7 | 7 | 11.8 | 15.9 | 16 | 21.4 | 21.8 | 22.1 | 22.1 | 22.2 | 22.3 |
| Total | 1 | 4.9 | 5.1 | 5.2 | 7.1 | 8.8 | 8.9 | 12.7 | 13.2 | 13.5 | 13.6 | 13.7 | 13.9 |
| Najran | | | | | | | | | | | | | |
| Najran City | 1 | 3.3 | 3.7 | 3.9 | 4.7 | 5.6 | 5.7 | 6.7 | 6.9 | 7.1 | 7.2 | 7.2 | 7.3 |
| Sharorah | 1 | 3.8 | 3.9 | 4.1 | 4.6 | 5.3 | 5.3 | 6.6 | 6.7 | 6.8 | 6.8 | 6.8 | 6.8 |
| Rest of Najran | 1 | 5.8 | 6.7 | 7.3 | 11.8 | 18.8 | 18.9 | 25.2 | 25.3 | 25.5 | 25.6 | 25.6 | 25.7 |
| Total | 1 | 3.6 | 3.9 | 4.2 | 5.1 | 6.5 | 6.5 | 8 | 8.1 | 8.3 | 8.4 | 8.4 | 8.5 |
| Al-Baha | | | | | | | | | | | | | |
| Al-Baha City | 1 | 2.1 | 2.4 | 2.7 | 3.3 | 4.8 | 8.1 | 8.1 | 9.7 | 11.3 | 11.8 | 12.3 | 12.6 |
| Al-Mukhwah | 1 | 4.5 | 6.2 | 6.4 | 7.6 | 8.3 | 10.8 | 10.8 | 11.3 | 11.5 | 11.5 | 11.6 | 11.6 |
| Biljurashi | 1 | 9.5 | 11.6 | 12.8 | 19.7 | 23.6 | 27 | 27 | 28.3 | 29.3 | 29.5 | 29.7 | 30.1 |
| Rest of Al-Baha | 1 | 7.5 | 9.2 | 9.9 | 10.6 | 11.7 | 15.3 | 15.3 | 15.8 | 16.3 | 16.3 | 16.3 | 16.5 |
| Total | 1 | 5.3 | 6.6 | 7.1 | 8.9 | 10.5 | 13.7 | 13.7 | 14.7 | 15.7 | 15.9 | 16.1 | 16.3 |
| Al-Jouf | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|-----------------|---|-----|-----|-----|------|------|------|------|------|------|------|------|------|
| Sakaka | 1 | 5.6 | 6.1 | 7.5 | 11.1 | 11.1 | 11.1 | 15.5 | 15.8 | 16.2 | 16.3 | 16.4 | 16.7 |
| Rest of Al-Jouf | 1 | 3.4 | 4.5 | 6.1 | 10.8 | 10.8 | 10.8 | 15.1 | 15.2 | 15.4 | 15.4 | 15.4 | 15.4 |
| Total | 1 | 4.4 | 5.2 | 6.8 | 10.9 | 10.9 | 10.9 | 15.3 | 15.5 | 15.8 | 15.8 | 15.9 | 16 |
| Country total | 1 | 1.7 | 1.9 | 2 | 2.5 | 2.8 | 2.9 | 3.9 | 4.1 | 4.2 | 4.3 | 4.3 | 4.4 |

Infections Per Population (1000 Persons)

Absolute numbers, percentages, and proportions explain the spread of COVID-19 in a population, especially in Saudi Arabia, which has an unevenly distributed population. More than half of the population is concentrated in Riyadh, Makkah, and the Eastern Region administrative areas, where major administrative, educational, health, and developmental infrastructure are concentrated; 71 percent of COVID-19 infections occurred in areas that comprised 67.6% of the total population.

As the total infection rate in the country was 26.3 per 1,000 persons, as per Q2 2023, administrative areas could be divided into three categories: more or less than the national average (25–30), lower than the national average (less than 25), and higher than the national average (more than 30). The first group comprised Riyadh (27), Makkah (26), Al-Madina (27), Aseer (27), Jazan (24), and Najran (24). There were many seriously affected locations in the Riyadh Administrative area, including Wadi Ad Dawasir (11–65), followed by Hawtat Bani Tamim (9–61), Ad Dilam (2–47), and Afif (2–36). While Al-Kharj (3–14), the rest of Riyadh (3–16), and Ad Duwadimi (1–24) had low levels of spread, Riyadh City had a spread close to the total (7–28). In the Makkah administrative area, infection was widespread in Al-Lith (5–186), Khulays (18–154), and Al-Kamil (1–77). Makkah and Jeddah cities/governorates were less infected (10–26 and 7–26, respectively) than Al-Qunfudhah (5–51), Rabigh (2–36), and Taif (10–41).

The remaining area was infected at a slower rate. The Al-Madina administrative area experienced a slow spread with an infection rate of seven in the beginning, which increased to 27 towards the end, with some towns/governorates having higher infections per 1,000 persons, such as Khaybar (2–87), Yanbu (4–44), and Al-Ula (1–42). Al-Mahd (2–23) and Al-Madina City (10–26) showed a low spread. The Aseer administrative area had many locations affected by the widest spread, including Ballasmar (8–278), Sarat Abidah (5–97), and Zahran Al-Janub (4–72). Other localities/towns were less affected but had varying intensities, including Bishan (5–24) and Khamis Mushayt (5–24), followed by the rest of Aseer (2–16). Other locations, such as Abha, Ahad Rufaydah, Muhayil, and Rijal Al-Ma, were moderately affected. In the case of the Jazan administrative area, Baysh was the worst-affected town/governorate (32–134) from the beginning, followed by Abu Arish (2–67), Jazan City (3–60), Samtah (4–54), and Sabya (3–45). The other localities in the rest of the Jazan administrative area were generally less affected. The last one in the group was

the Najran administrative area, with two major affected locations: Najran City (3–23) and Sharorah Town (4–25). While this area was less widely affected (3–24), Sharorah was more affected than Najran City, the headquarters.

The second category comprises Al-Jouf, Hail, Tabouk, the Northern Borders, and Al-Qasim administrative areas, with less serious threats that were less widespread. Among these, the first three indicated a smaller spread, whereas the fourth indicated a major spread. As expected, rural Al-Jouf was not seriously affected except for the headquarters of Sakaka, where the spread was slightly slower and less threatening. However, in the Hail administrative area, there was a reasonably serious threat to the headquarters, Hail City, with 3–25 infections per 1,000 persons; other parts had a smaller spread (0–12). In contrast, the Tabouk administrative area was less widely affected (2–14), with Tabouk City (2–14) and the rest (1–14) showing mild attacks. In the Northern Borders administrative area, this epidemic spread very sparsely; the two affected locations were Arar (1–22) and Rafha (1–19), which showed lesser spread than that in other cities and towns. Other localities also had a similar pattern of spread, albeit less than what was previously mentioned, with Al-Qasim being a major administrative area that managed to largely contain the epidemic. Its spread was contained within 3–22 per 1000 individuals but with less geographical spread. Riyadh Al-Khabra was the most widely affected location (3–58), followed by Al-Midhnaab (5–54), Al-Bada'i (2–31), and Unayzah (3–30), whereas the least affected locations were Buraydah and the rest of Al-Qasim.

The administrative areas, namely Al-Baha, the Northern Borders, and the Eastern Region, were negatively affected considering the share of the population. Although small, the Al-Baha administrative area had a large infection attack rate, not in its headquarters (3–34), Al-Baha City, but in Biljurashi (3–86) and Al-Mukhwah (4–52), whereas other locations had a smaller spread (1–19). The Eastern Region has received wide attention in the context of COVID-19, where the spread began, creating huge emergencies. Several cities, towns, and governorates were widely infected, giving rise to higher-than-national average scenarios of emergencies. Out of all the locations, the worst affected were Safwa (25–173) and Al-Qatif (61–143), followed by Al-Nuayriyah (6–77), Adh Dhanran (16–71), Buqayq (11–70), and Al-Jubayl (23–60). The least affected locations in this administrative area were Ad Dammam (9–30), Ras Tannurah (10–33), and Al Khubar (13–34).

Table 2: Patterns of COVID-19 spread per 1000 individuals for various locations in each administrative area by quarters of 2020, 2021, 2022, and 2023.

| Administrative area/ Location | 2020 | | | 2021 | | | | 2022 | | | | 2023 | |
|-------------------------------|------|----|----|------|-----|-----|-----|------|-----|-----|-----|------|-----|
| | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 |
| Riyadh | | | | | | | | | | | | | |
| Ad Diriyah | 22 | 24 | 25 | 26 | 27 | 28 | 28 | 31 | 31 | 31 | 32 | 32 | 32 |
| Afif | 2 | 10 | 12 | 14 | 21 | 26 | 26 | 32 | 34 | 35 | 35 | 35 | 36 |
| Ad Duwadimi | 1 | 5 | 6 | 7 | 11 | 13 | 13 | 20 | 21 | 22 | 23 | 23 | 24 |
| Ad Dilam | 2 | 8 | 12 | 23 | 34 | 37 | 37 | 45 | 47 | 47 | 47 | 47 | 47 |
| Al-Kharj | 3 | 5 | 5 | 7 | 8 | 9 | 9 | 12 | 14 | 14 | 14 | 14 | 14 |
| Al-Majmaah | 4 | 10 | 15 | 18 | 22 | 25 | 25 | 30 | 31 | 32 | 32 | 32 | 32 |
| Hawtat Bani Tamim | 9 | 21 | 24 | 31 | 43 | 47 | 47 | 57 | 60 | 60 | 61 | 61 | 61 |
| Riyadh City | 7 | 8 | 9 | 10 | 14 | 15 | 16 | 24 | 26 | 27 | 28 | 28 | 28 |
| Wadi Ad Dawasir | 11 | 26 | 32 | 36 | 48 | 54 | 55 | 60 | 62 | 63 | 64 | 65 | 65 |
| Rest of Riyadh | 3 | 6 | 6 | 8 | 10 | 11 | 11 | 15 | 15 | 15 | 16 | 16 | 16 |
| Total | 6 | 8 | 9 | 11 | 14 | 16 | 16 | 23 | 25 | 26 | 26 | 27 | 27 |
| Makkah | | | | | | | | | | | | | |
| Al-Kamil | 1 | 11 | 14 | 16 | 37 | 51 | 51 | 76 | 77 | 77 | 77 | 77 | 77 |
| Al-Lith | 5 | 30 | 33 | 43 | 102 | 112 | 113 | 184 | 186 | 186 | 186 | 186 | 186 |
| Jeddah | 7 | 9 | 9 | 10 | 13 | 14 | 15 | 21 | 24 | 25 | 25 | 26 | 26 |
| Khulays | 18 | 46 | 52 | 53 | 62 | 65 | 66 | 152 | 154 | 154 | 154 | 154 | 154 |
| Makkah City | 10 | 14 | 15 | 15 | 18 | 19 | 20 | 24 | 26 | 26 | 26 | 26 | 26 |
| Al-Qunfudhah | 5 | 23 | 24 | 26 | 37 | 43 | 43 | 50 | 51 | 51 | 51 | 51 | 51 |
| Rabigh | 2 | 4 | 4 | 4 | 6 | 7 | 8 | 34 | 35 | 36 | 36 | 36 | 36 |
| Taif | 10 | 19 | 20 | 21 | 26 | 30 | 30 | 36 | 38 | 39 | 40 | 40 | 41 |
| Rest of Makkah | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| Total | 7 | 10 | 11 | 12 | 15 | 17 | 17 | 23 | 24 | 25 | 25 | 26 | 26 |
| Al-Madina | | | | | | | | | | | | | |
| Al-Ula | 1 | 6 | 7 | 8 | 11 | 19 | 19 | 39 | 40 | 41 | 41 | 42 | 42 |
| Khaybar | 2 | 17 | 25 | 27 | 40 | 53 | 54 | 84 | 86 | 87 | 87 | 87 | 87 |
| Al-Mahd | 2 | 8 | 10 | 12 | 13 | 14 | 14 | 23 | 23 | 23 | 23 | 23 | 23 |
| Yanbu | 4 | 13 | 20 | 21 | 31 | 34 | 35 | 42 | 43 | 43 | 43 | 44 | 44 |
| Al-Madina City | 10 | 14 | 16 | 16 | 18 | 18 | 18 | 23 | 25 | 26 | 26 | 26 | 26 |
| Rest of Al-Madina | 0 | 2 | 3 | 3 | 5 | 7 | 7 | 11 | 11 | 11 | 11 | 11 | 11 |
| Total | 7 | 12 | 14 | 15 | 18 | 19 | 20 | 24 | 26 | 26 | 26 | 26 | 27 |
| Al-Qasim | | | | | | | | | | | | | |
| Al-Badai | 2 | 10 | 12 | 13 | 17 | 22 | 23 | 30 | 31 | 31 | 31 | 31 | 31 |
| Al-Midhnab | 5 | 24 | 29 | 30 | 36 | 45 | 45 | 53 | 54 | 54 | 54 | 54 | 54 |
| Ar Rass | 3 | 10 | 10 | 11 | 11 | 12 | 12 | 22 | 24 | 25 | 25 | 26 | 26 |
| Buraydah | 4 | 9 | 10 | 10 | 12 | 13 | 14 | 17 | 18 | 18 | 19 | 19 | 19 |
| Riyadh Al-Khabra | 3 | 19 | 26 | 27 | 37 | 47 | 47 | 58 | 58 | 58 | 58 | 58 | 58 |
| Unayzah | 3 | 11 | 13 | 14 | 17 | 21 | 21 | 27 | 28 | 29 | 30 | 30 | 30 |
| Rest of Al-Qasim | 1 | 6 | 7 | 8 | 10 | 13 | 13 | 16 | 16 | 16 | 16 | 16 | 16 |
| Total | 3 | 9 | 11 | 11 | 14 | 17 | 17 | 21 | 21 | 21 | 22 | 22 | 22 |

| | | | | | | | | | | | | | |
|----------------------------|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Eastern Region | | | | | | | | | | | | | |
| Al-Jubayl | 23 | 31 | 33 | 35 | 40 | 46 | 47 | 56 | 57 | 58 | 59 | 59 | 60 |
| Al-Khafji | 3 | 9 | 11 | 14 | 24 | 32 | 32 | 41 | 42 | 43 | 43 | 43 | 44 |
| Al-Mubarraz | 9 | 26 | 28 | 29 | 35 | 37 | 38 | 43 | 43 | 43 | 43 | 44 | 44 |
| Al-Nuayriyah | 6 | 26 | 30 | 33 | 57 | 66 | 66 | 76 | 77 | 77 | 77 | 77 | 77 |
| Buqayq | 11 | 31 | 34 | 40 | 53 | 59 | 60 | 69 | 69 | 70 | 70 | 70 | 70 |
| Ad Dammam | 9 | 14 | 14 | 15 | 17 | 18 | 18 | 25 | 28 | 29 | 29 | 29 | 30 |
| ADh Dhahran | 16 | 29 | 31 | 35 | 43 | 48 | 49 | 60 | 65 | 67 | 68 | 70 | 71 |
| Hafar Al-Batin | 3 | 11 | 11 | 11 | 12 | 14 | 14 | 17 | 18 | 18 | 18 | 18 | 18 |
| Al-Hufuf | 26 | 45 | 47 | 49 | 54 | 56 | 57 | 73 | 76 | 77 | 78 | 78 | 79 |
| Al-Khubar | 13 | 18 | 18 | 19 | 21 | 24 | 24 | 31 | 32 | 33 | 33 | 33 | 34 |
| Al-Qatif | 61 | 93 | 96 | 101 | 106 | 112 | 113 | 138 | 140 | 141 | 142 | 143 | 143 |
| Ras Tannurah | 10 | 19 | 20 | 21 | 22 | 24 | 24 | 33 | 33 | 33 | 33 | 33 | 33 |
| Safwa | 25 | 65 | 73 | 82 | 113 | 131 | 131 | 167 | 170 | 172 | 172 | 172 | 173 |
| Rest of the Eastern Region | 1 | 2 | 2 | 2 | 3 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| Total | 10 | 17 | 18 | 19 | 22 | 24 | 24 | 29 | 31 | 31 | 32 | 32 | 32 |
| Aseer | | | | | | | | | | | | | |
| Abha | 6 | 15 | 16 | 16 | 21 | 25 | 26 | 36 | 39 | 41 | 41 | 41 | 42 |
| Ahad Rufaydah | 5 | 16 | 17 | 17 | 19 | 21 | 21 | 28 | 28 | 29 | 29 | 29 | 29 |
| Ballasmar | 8 | 84 | 106 | 112 | 173 | 249 | 249 | 267 | 272 | 277 | 277 | 277 | 278 |
| Bishah | 5 | 13 | 14 | 14 | 17 | 19 | 19 | 22 | 23 | 23 | 23 | 24 | 24 |
| Zahrn Al-Janub | 4 | 23 | 28 | 30 | 49 | 59 | 59 | 70 | 71 | 71 | 71 | 72 | 72 |
| Khamis Mushayt | 5 | 14 | 15 | 15 | 18 | 20 | 20 | 23 | 23 | 24 | 24 | 24 | 24 |
| Muhayil | 6 | 16 | 17 | 17 | 20 | 22 | 22 | 32 | 32 | 33 | 33 | 34 | 34 |
| Rijal Al-Ma | 2 | 15 | 18 | 18 | 23 | 28 | 28 | 34 | 34 | 34 | 34 | 34 | 34 |
| Sarat Abidah | 5 | 32 | 36 | 36 | 38 | 39 | 39 | 78 | 84 | 87 | 90 | 93 | 97 |
| Rest of Aseer | 2 | 9 | 9 | 9 | 11 | 13 | 13 | 15 | 15 | 16 | 16 | 16 | 16 |
| Total | 4 | 13 | 14 | 15 | 18 | 21 | 21 | 25 | 26 | 27 | 27 | 27 | 27 |
| Tabouk | | | | | | | | | | | | | |
| Tabouk City | 2 | 6 | 7 | 7 | 9 | 10 | 10 | 13 | 13 | 14 | 14 | 14 | 14 |
| Rest of Tabouk | 1 | 3 | 3 | 4 | 6 | 8 | 8 | 14 | 14 | 14 | 14 | 14 | 14 |
| Total | 2 | 5 | 6 | 6 | 8 | 10 | 10 | 13 | 13 | 14 | 14 | 14 | 14 |
| Hail | | | | | | | | | | | | | |
| Hail City | 3 | 12 | 14 | 15 | 17 | 20 | 20 | 24 | 24 | 25 | 25 | 25 | 25 |
| Rest of Hail | 0 | 3 | 4 | 4 | 7 | 9 | 9 | 12 | 12 | 12 | 12 | 12 | 12 |
| Total | 2 | 9 | 10 | 11 | 14 | 16 | 16 | 19 | 19 | 20 | 20 | 20 | 21 |
| Northern Borders | | | | | | | | | | | | | |
| Arar | 1 | 6 | 7 | 10 | 13 | 16 | 17 | 21 | 21 | 22 | 22 | 22 | 22 |
| Rafha | 1 | 6 | 7 | 8 | 9 | 15 | 15 | 19 | 19 | 19 | 19 | 19 | 19 |
| Rest of Northern Borders | 2 | 4 | 5 | 7 | 8 | 9 | 10 | 13 | 13 | 13 | 13 | 13 | 13 |
| Total | 1 | 6 | 7 | 9 | 12 | 15 | 15 | 18 | 18 | 19 | 19 | 19 | 19 |
| Jazan | | | | | | | | | | | | | |
| Abu Arish | 2 | 21 | 21 | 22 | 34 | 45 | 46 | 62 | 64 | 65 | 65 | 66 | 67 |

| | | | | | | | | | | | | | |
|----------------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Baysh | 32 | 70 | 70 | 71 | 81 | 88 | 89 | 126 | 129 | 130 | 132 | 132 | 134 |
| Jazan City | 3 | 19 | 21 | 21 | 26 | 32 | 33 | 51 | 54 | 56 | 58 | 59 | 60 |
| Sabya | 3 | 17 | 17 | 18 | 23 | 27 | 27 | 42 | 44 | 45 | 45 | 45 | 45 |
| Samtah | 4 | 23 | 24 | 24 | 30 | 35 | 35 | 49 | 50 | 51 | 52 | 53 | 54 |
| Rest of Jazan | 0 | 2 | 2 | 3 | 4 | 6 | 6 | 8 | 8 | 8 | 8 | 8 | 8 |
| Total | 2 | 9 | 9 | 9 | 13 | 16 | 16 | 22 | 22 | 23 | 23 | 23 | 24 |
| Najran | | | | | | | | | | | | | |
| Najran City | 3 | 11 | 12 | 12 | 15 | 18 | 18 | 21 | 22 | 22 | 23 | 23 | 23 |
| Sharorah | 4 | 14 | 14 | 15 | 17 | 19 | 19 | 24 | 25 | 25 | 25 | 25 | 25 |
| Rest of Najran | 1 | 5 | 6 | 7 | 11 | 18 | 18 | 24 | 24 | 24 | 24 | 24 | 24 |
| Total | 3 | 10 | 11 | 12 | 15 | 19 | 19 | 22 | 23 | 23 | 23 | 23 | 24 |
| Al-Baha | | | | | | | | | | | | | |
| Al-Baha City | 3 | 6 | 6 | 7 | 9 | 13 | 13 | 22 | 26 | 31 | 32 | 33 | 34 |
| Al-Mukhwah | 4 | 20 | 28 | 29 | 34 | 37 | 38 | 49 | 51 | 52 | 52 | 52 | 52 |
| Biljurashi | 3 | 27 | 33 | 37 | 56 | 67 | 68 | 77 | 81 | 84 | 84 | 85 | 86 |
| Rest of Al-Baha | 1 | 9 | 11 | 12 | 12 | 14 | 14 | 18 | 19 | 19 | 19 | 19 | 19 |
| Total | 2 | 11 | 14 | 15 | 19 | 22 | 22 | 28 | 30 | 32 | 32 | 32 | 33 |
| Al-Jouf | | | | | | | | | | | | | |
| Sakaka | 1 | 3 | 3 | 4 | 5 | 6 | 6 | 9 | 9 | 9 | 9 | 9 | 10 |
| Rest of Al-Jouf | 0 | 1 | 1 | 2 | 3 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| Total | 0 | 2 | 2 | 3 | 4 | 5 | 5 | 6 | 6 | 7 | 7 | 7 | 7 |
| Country total | 6.1 | 10.6 | 11.5 | 12.7 | 15.9 | 17.8 | 18.1 | 23.3 | 24.7 | 25.4 | 25.7 | 25.9 | 26.3 |

In addition to the pattern of spread based on population size, per 1000 individuals, there were seasonal patterns as well, which might be like those mentioned in the previous section regarding the increase in COVID-19 spread (Table 2).

Discussions

Saudi Arabia witnessed the COVID-19 pandemic across the country in administrative areas and almost all governorates with varying numbers of cases, speed, intensity, and share of the population. From the beginning of the infection, Saudi Arabia experienced highs and lows based on population size, urban growth, infrastructure, and economic sectors. For example, a high spread of the disease was reported in Riyadh, Makkah, and administrative areas of the Eastern Region. The second set of regions included Al-Madina, Aseer, Al-Qasim, and Jazan. Other regions had fewer infections. These could directly relate to urbanization, social and religious gatherings, commercial activities, and workplaces, despite the effective implementation of various containment measures all over the country, with seasonal variations.

Almost all administrative areas passed the peak stage of infection, and thereby marked declines with substantial public health measures in place to confront political, monetary, and social difficulties.^{17,18} Moreover, most of the cases constituted of

travelers from other countries in the Eastern Region and contacts in the Riyadh, Makkah, and Al-Madina administrative areas, apart from medical professionals.²¹ In addition, metropolitan cities, such as Makkah, Riyadh, Jeddah, and Al-Madina, had been seriously affected by overcrowding in residences, workplaces, religious places, commercial outlets, and social entertainment sites.⁹ This regional disparity may be attributed to population size, population density, and professions that require travel. While the former administrative areas were urban centers, the others were hill stations with agricultural professions. It could be presumed that regions with more interpersonal contacts and dealings had more infections than other regions. This relates to the epidemic etiology and seasonal variations explained by scientists and medical professionals.

Apart from major metropolitan cities, administrative headquarters and smaller cities were infected in large numbers. In urban areas, owing to frequent movements and interpersonal contacts characterized by tertiary-level professions, there was a risk of asymptomatic transmission between travelers and their immediate contacts, which drove the growth of the pandemic, where frequent testing and social distancing, as countermeasures, were impractical, especially during peak seasons.^{22,23} Such frequent incidences occurred in urban centers in Riyadh (Ad Diriyah, Al-Kharj, and Wadi Ad Dawasir), Makkah (Taif), Al-

Madina (Yanbu), Al-Qasim (Al-Badai, Ar Rass, and Buraydah), the Eastern Region (Al-Jubayl, Al-Mubarraz, Al-Nuayriyah, etc.), Aseer (Abha, etc.), Tabouk (Tabouk), Hail (Hail), the Northern Borders (Arar), Jazan (Abu Arish etc.), Najran (Najran, Sharorah), Al-Baha (Biljurashi), and Al-Jouf (Sakaka). These were either administrative headquarters or major cities and townships with augmented population growth and economic infrastructure. The first case was detected in Al-Qatif, a medium-sized city. 24 Cities differ in demographic attributes, such as sex ratio, child population, geographical conditions, environmental situation, and availability of resources, such as hospitals and medical facilities.

This causes differences in monthly infected cases, increase in infection, and share of individuals infected, with differences across administrative areas and locations. In addition, there were differences in the spread across administrative areas and governorates depending on population, infrastructure, and professions. Fewer prospective administrative areas had lesser spread, confirming the effects of crowding, interpersonal contact, commercial establishments, and professions. This highlights the importance of emergency preparedness during epidemics. However, infections in such prominent administrative areas cannot be higher in terms of ratios and proportions based on population size, and are often higher in major urban pockets, locations, and townships. That is, the second-order administrative areas, cities, and neighborhoods were found to be at risk in terms of rapid growth and wider infections, such as Ballasmar, Safwa, ADh Dhahran, Wadi Ad Dawasir, Baysh, and Jazan.

Conclusion

Despite strenuous efforts by the Saudi Arabian Ministry of Health in coordination with other governmental and non-governmental agencies, COVID-19 spread rapidly in the country, with spatial and seasonal differences across administrative areas, major cities, and major residential and commercial locations. Out of the 13 administrative areas, Riyadh, Makkah, and the Eastern Region reported disease widespread; Al-Madina, Al-Qasim, Aseer, and Jazan had a medium level of spread; and Tabouk, Hail, the Northern Borders, Najran, Al-Baha, and Al-Jouf had a low level of spread. This classification could be related to the distribution of population and infrastructure in the country. Major cities, such as Riyadh, Jeddah, Makkah, Al-Madina, Buraydah, and Ad Dammam, faced a high level of spread, both in terms of the number of infected individuals and its increase, as there were certain locations, such as headquarters of governorates (Taif, Khamis Mushayt, Samtah, Biljurashi, Wadi Ad Dawasir, Yanbu, Ar Rass, etc.) and other major residential and commercial locations (Al-Mubarraz, Al-Hufuf, Safwa, Ballasmar, etc.), that were reported to have a high rate of COVID-19 infection.

The increase in COVID-19 infection in the country during the peak seasons of Q3 2020, Q2 2021, and Q1 2022 threatened

human lives, causing anxiety and apprehension. A significant increase was reported in the major administrative areas of Riyadh, Makkah, Al-Madina, Al-Qasim, and the Eastern Region. In addition, the increases in Wadi Ad Dawasir, Taif, Ar Rass, Al-Jubayl, Al-Hufuf, Safwa, Khamis Mushayt, Samtah, and Biljurashi were faster. In other words, the number of upcoming townships and promising future cities were impacted by the rapid increase. In these specified locations, the infection spread to a major share of the population. Based on the statistics of the spread of COVID-19, administrative areas were divided into three categories: major spread (Al-Baha, the Northern Borders, and the Eastern Region), medium spread (Riyadh, Makkah, Al-Madina, Aseer, Najran, and Jazan), and low spread (Al-Qasim, Al-Jouf, Hail, and Tabouk). This classification provides insights into emergency preparedness, strategies for controlling and combating infectious diseases, and future considerations. It also highlights the need to concentrate on medium-sized and upcoming neighborhoods that are fast-growing in terms of population and infrastructure.

References

1. Yezli S, Khan A (2020) COVID-19 social distancing in the Kingdom of Saudi Arabia: Bold measures in the face of political, economic, social, and religious challenges. *Travel Med Infect Dis* 37: 101692.
2. Aldossari HM (2023) Exploring interrelationships of COVID-19 dimensions in Saudi Arabia: a systematic review. *Bulletin of National Research Center* 47(1): 73.
3. Salam AA, Al Khraif RM, Elsegaey I (2022) COVID-19 in Saudi Arabia: An Overview. *Front Public Health* 2: 9: 736942.
4. Salam AA, Al Khraif RM, Dilip TR, Elsegaey I (2022) Coronavirus disease 2019 in proportion to population: a historical analysis of Saudi Arabia. *Bull Natl Res Cent* 46(1): 198.
5. Salam AA, Khraif R, Dilip TR, Elsegaey I (2021) COVID in Saudi Arabia: trends and patterns of spread. *IIPS International Seminar* 18-20.
6. Alabdulkarim N, Alsultan F, Bashir S (2020) Gulf Countries Responding to COVID-19. *Dubai Medical Journal* 3(1): 58-60.
7. Alanezi F, Aljahdali A, Alyousef S, Hebah Alrashed, Wyam Alshaikh, et al (2020) Implications of Public Understanding of COVID-19 in Saudi Arabia for Fostering Effective Communication Through Awareness Framework. *Front in Public Health* 8: 494.
8. Alqarni MS, Alghamdi M, Muhammad T, Alshomrani AS, Khan MA (2022) Mathematical modeling for novel coronavirus (COVID-19) and control. *Numer Methods Partial Differ Equs* 38(4): 760-776.
9. Alyami MH, Naser AY, Orabi MAA, Alwafi H, Alyami HS (2020) Epidemiology of COVID-19 in the Kingdom of Saudi Arabia an Ecological Study. *Front Public Health* 8: 506.
10. Obied DA, Alhamlan FS, Alqahtani AA, Alahdal MN (2020) Containment of COVID-19: the unprecedented response of Saudi Arabia. *J Infect Dev Ctries* 14(7): 699-706.
11. Ismail A, Alagha O (2021) The impact of COVID-19 lockdown on the air quality of Eastern Province, Saudi Arabia. *Air Qual Atmos Health* 14(1): 117-128.
12. Barry M, Al Amri M, Memish ZA (2020) COVID-19 in the Shadows of MERS-CoV in the Kingdom of Saudi Arabia. *J Epidemiol Glob Health* 10(1): 1-3.

13. Almaghlouth I, Islam T, Alamro N, et al. Mapping COVID-19 related research from Saudi Arabia, a scoping review. *Between reality and dreams Saudi Med J* 41(8): 791-801.
14. Al Otaibi ST (2020) The battle against Coronavirus disease 2019 (COVID-19) in the Kingdom of Saudi Arabia. *Public health perspective Saudi Med J* 41(12): 1285-1291.
15. Alrasheed H, Althnian A, Kurdi H, Al-Mgren H, Alharbi S (2020) COVID-19 Spread in Saudi Arabia: Modeling, Simulation and Analysis. *Int J Environ Res Public Health* 17(21): 7744.
16. Barry M, Ghonem L, Alsharidi A, Alanazi A, Alotaibi NH, et al. (2020) Coronavirus disease-2019 pandemic in the Kingdom of Saudi Arabia: mitigation measures and hospital preparedness. *Journal of natural science and medicine* 3(3): 155-158.
17. Esmat MAE (2020) How AI, Data science and technology is used to fight the pandemic COVID-19: case study in Saudi Arabia Environment. *Research in the world economy* 11(5): 409-419.
18. Ahmad N (2020) COVID-19 Modeling in Saudi Arabia Using the Modified Susceptible-Exposed-Infectious Recovered (SEIR) Model *Cureus* 12(9): e10452.
19. Baz A, Alhakami H (2021) Fuzzy Based Decision-Making Approach for Evaluating the Severity of COVID-19 Pandemic in Cities of Kingdom of Saudi Arabia. *Computers, Materials & Continua* 66(2): 1155-1147.
20. Jokhdar H, Khan A, Asiri S, Motair W, Assiri A, et al. (2021) COVID-19 Mitigation Plans During Hajj 2020: A Success Story of Zero Cases. *Health Secur* 19(2): 133-139.
21. Jdaitawi M, Jdaitawi L, Alkurdi R (2020) Analyzing the spread of COVID-19 in Saudi Arabia and controlling disease strategies. *International journal of internal and emergency medicine* 3(1): 1028.
22. Abohamr SI, Abazid RM, Aldossari MA, Hala A Amer, Omar S Badhawiet, et al. (2020) Clinical characteristics and in-hospital mortality of COVID-19 adult patients in Saudi Arabia. *Saudi Med J* 41(11): 1217-1226.
23. Alshammari FS (2020) A Mathematical Model to Investigate the Transmission of COVID-19 in the Kingdom of Saudi Arabia. *Comput and Math Methods Med* 9136157.
24. Khoshaim HB, Al Sukayt A, Chinna K, Mohammad Nurunnabi, Sheela Sundarasan, et al. (2020) Anxiety Level of University Students During COVID-19 in Saudi Arabia. *Front Psychiatry* 11: 579750.



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