GEORGIAN

MEDICAL

NEWS

ТБИЛИСИ - NEW YORK

ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned
Requirements are not Assigned to be Reviewed.**

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**,ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შედგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმების (ინგლისურ,რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენ-ტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ,რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი,მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემა-ჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტო-სურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი,ანათლების შედებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სუ-რათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხო-ური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიდრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამული, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი,წელი,ჟურნალის №,პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიდრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანე-ლის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა,მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა,რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შე-ჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

Содержание:

THE PREVALENCE OF COVID-19 IN THE COUNTRIES OF THE GULF COOPERATION COUNCIL: AN EXAMINATION AFTER THREE YEARS

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Abstract.

Objectives: The coronavirus disease (COVID-19) pandemic in the Gulf Cooperation Council (GCC) countries is part of the global pandemic. So, the current study used COVID-19 statistics to examine the COVID-19 prevalence in the GCC countries by the end of 2020, 2021, and 2022 and compare the findings to non-GCC Arab countries and also compare 2022's results globally.

Methods: COVID-19 data per country, including the vaccination coverage rate, were obtained from well-known publicly online websites (such as Worldometer and Our World in Data). An Independent sample t-test was used to compare the means between the GCC and non-GCC Arab countries.

Results: By the end of 2022, most COVID-19 deaths in the GCC countries were recorded in Saudi Arabia but given the number of cases and deaths per million, Bahrain was the most affected. Saudi Arabia was the least testing country per population, while the United Arab of Emirates performed tests nearly 20 times more than its population. Qatar had the lowest case-fatality rate (0.14%). Statistically, the GCC countries had higher median age, higher mean cases per million, higher mean tests per population, and higher mean vaccination coverage (84.56%) than non-GCC Arab countries. Globally, the GCC countries recorded fewer deaths per million, performed more tests relative to the population, and had higher vaccination coverage.

Conclusions: Globally, the GCC countries have been less affected by the COVID-19 pandemic. However, statistics vary across the GCC countries. The average vaccination coverage in the Gulf countries was higher than in the global one. Given the natural immunity and the excellent vaccine coverage in the GCC countries, it is essential to reconsider the definition of a suspected case and establish more specific criteria for testing.

Key words. Case-fatality, coronavirus, Arab, SARS-CoV-2, testing, vaccine.

Introduction.

In December 2019, a series of pneumonia cases of unknown etiology emerged in Wuhan, China, with clinical presentations resembling viral pneumonia. Although the first cases appeared in late 2019, the cause was recognized in January 2020 [1]. Deep microbiological investigations discovered a novel coronavirus, which was named severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), whereas the infectious disease was called coronavirus disease 2019 (COVID-19) [1]. In the beginning, China experienced most of the burden associated with COVID-19 in the form of morbidity and mortality. Later, specifically in mid-February, the COVID-19 danger started to appear in other parts of the world, including Arab countries [2]. So, on March 11, 2020, the World Health Organization (WHO)

announced COVID-19 as a pandemic [3]. Since that time, the world has suffered from the pandemic unevenly [4].

Most symptomatic patients present with respiratory symptoms, and most patients have mild disease [1,3]. So, the WHO developed a case definition for COVID-19 [5]. A suspected case of SARS-CoV-2 infection includes a person meeting clinical or epidemiological criteria. The clinical criteria include acute onset of fever and cough; or acute onset of at least three of the following signs or symptoms: fever, cough, general weakness/fatigue, myalgia, headache, sore throat, coryza, dyspnea, nausea/diarrhea/anorexia. The epidemiological criteria require a history of contact with a probable (a patient who meets both the clinical and epidemiological criteria) or confirmed case. However, due to the high rate of asymptomatic SARS-CoV-2 infections [6], a confirmed case of COVID-19 does not require fulfilling the criteria for a suspected case but simply a positive nucleic acid amplification test [5].

The Gulf Cooperation Council (GCC) is an Arab regional political, economic, military, and security organization comprising six Arab countries that constitute most of the Arabian Peninsula, which is situated in Southwest Asia [7]. The countries of the GCC are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia (SA), and United Arab Emirates (UAE). These countries are also part of the 22 members of the Arab League. The first cases of SARS-CoV-2 in the GCC countries were declared in the UAE on January 29, 2020 [8]. In March 2020, the GCC countries began imposing several precautionary measures to control the virus's spread, such as mosques and educational institutes closures, suspending flights, and lockdowns with curfews [9]. Over time, most of these measures were phased out.

Over the three years, the Arab world has suffered in varying degrees. According to a recent study examining COVID-19 statistics in the Arab world at the end of October 2022, Arab countries have been less affected by the COVID-19 pandemic than the rest of the world [10]. The GCC countries have been the most tested Arab countries [10]. Globally, countries vary widely in their COVID-19 statistics. The rationale for these differences may be related to each country's resources, testing strategies, politics, health insurance systems, economies, reporting methods, and other undetermined factors [4,11]. Additionally, the differences in median age between countries influence the COVID-19 pandemic's course, as infections with SARS-CoV-2 cause a higher death rate in older than younger adults [1,4]. Furthermore, the difference in vaccination coverage is another crucial factor [10,12]. However, despite the deployment of COVID-19 vaccines in late 2020, the world suffered more in 2021 [10].

The COVID-19 pandemic in the GCC countries is part of the worldwide pandemic. Understanding the epidemiology of

COVID-19 in each region of the world helps researchers and decision-makers explore the best ways to deal with COVID-19 and may provide lessons for a more effective response to public health emergencies. Although some researchers have studied the epidemiology of COVID-19 in the GCC countries, understanding of COVID-19 is still evolving, and COVID-19 statistics are dynamic. Since the oil-rich GCC states are similar to a larger extent in socioeconomic aspects, environmental conditions, economy, and healthcare capacities [13], it is expected that the COVID-19 statistics would be consistent across the GCC countries but somewhat different from non-GCC Arab countries (Algeria, Comoros, Djibouti, Egypt, Iraq, Jordan, Lebanon, Libya, Mauritania, Morocco, Palestine, Sudan, Somalia, Syria, Tunisia, and Yemen). So, the purpose of the current study was to use COVID-19 statistics to examine the prevalence of COVID-19 in the GCC countries by the end of 2020, 2021, and 2022 and compare the findings to non-GCC Arab countries and also compare the 2022's results globally.

Materials and Methods.

Unless otherwise specified, data on COVID-19 were obtained from the "Worldometer" website [2]. The data on COVID-19 for all world countries/territories were copied and stored in Excel files at the end of 2020, 2021, and 2022 [2]. The data used in this analysis consists of the total number of COVID-19 cases per country, the total number of deaths, the total number of tests performed, the total number of cases per million population, the total number of deaths per million population, the total number of tests per million population, and the total population. Data from cruise ships were excluded.

According to the objectives, the required data for each GCC country were obtained from the stored files. In addition, the median age for Arab countries for 2021, which represents an average period for the three years 2020-2022, was extracted from the United Nations website [14]. The "Our World in Data" website was also searched to extract the vaccination coverage rate (people with a complete initial protocol: two doses) by the end of 2021 and 2022 for the countries included in the study [12]. We considered the first of January of the years 2022 and 2023 to extract the updated vaccination data. The case-fatality rate (CFR) was calculated by dividing the number of deaths by the number of confirmed cases. Results were presented as numbers, percentages, or rates as appropriate.

Additionally, to evaluate the impact of the pandemic on the GCC countries to the globe, the mean CFR, the mean deaths per million, the mean cases per million, and the mean tests per population for all world countries/territories and per continent were measured. Also, by a similar method, COVID-19 statistics for the GCC countries have been compared to non-GCC Arab countries by the end of 2020, 2021, and 2022. To avoid using too many digits, the number of tests per population is calculated, instead of the number of tests per million, by dividing the number of tests by the population.

Statistical analysis was conducted using Statistical Package for Social Sciences (SPSS, version 26). An Independent sample t-test was used to compare the means between the GCC and non-GCC countries. A p-value of less than 0.05 was considered significant. Ethical approval from an Institutional Review Board was not required due to the secondary analysis of publicly available data.

Results.

By the end of 2020, most of the deaths attributed to COVID-19 (62.72%) in the GCC countries were recorded in SA, but, given the number of deaths per million, Oman was the most affected GCC country. On the other hand, Bahrain recorded the most cases relative to the population, followed by Qatar. At the same time, the UAE performed the highest number of tests in terms of population, as shown in Table 1. Additionally, the CFR ranged from 0.17% to 1.72%.

By the end of 2021, Bahrain became the GCC country most affected by the pandemic, according to the number of cases and deaths per million. The UAE performed nearly 111 million COVID-19 tests, eleven times more than its population. The CFR in SA was the highest and did not change much compared to the end of 2020, dropping from 1.72% to 1.60%. The vaccination coverage rate in the GCC countries ranged from about 63% to 96%, see Table 2.

COVID-19 statistics between the GCC countries mostly stayed the same in 2022, although cases increased by about sixty percent (see Table 3). According to the number of cases per million, SA was the least affected by the pandemic. At the same time, Qatar was the least affected based on the number of deaths per million. The CFRs ranged from 0.14% in Qatar to 1.15% in SA. The lowest vaccination coverage rate was seen in Oman (66.62%).

Tables 4 and 5 show COVID-19 statistics for the GCC countries (six countries) compared to non-GCC Arab countries (16 countries) by the end of 2020, 2021, and 2022. By the end of 2022, most COVID-19 tests were conducted in the GCC countries, even though they represent only 13% of the population of Arab countries. By another calculation, the GCC countries performed tests approximately five times their population, while non-GCC Arab countries performed tests equivalent to 16% of their population. In 2021, the number of tests conducted by GCC countries increased fivefold. The CFR was higher in non-GCC Arab countries throughout the three years. The GCC countries recorded more cases per million than other Arab countries, while the number of deaths per million was nearly close. Statistically, there was a significant difference in the mean tests per population and the mean vaccination coverage rate between the GCC and non-GCC Arab countries (see Table 5). The GCC countries had higher average cases per million than non-GCC Arab countries by the end of 2021 and 2022. There was also a significant difference in the mean median age; 33 (SD ±3.55) in GCC countries vs. 22.7 (SD ±4.74) in non-GCC Arab countries (P=.000).

On the other hand, by looking at Table 6, it is possible to compare COVID-19 statistics for the GCC countries globally and with each continent by the end of 2022. In comparison with the world countries, the GCC countries had lower CFR, lower mean CFR, lower mean cases per million, and lower mean deaths per million. Also, they recorded fewer deaths per million (346 vs. 843). In contrast, the GCC countries have performed more tests relative to the population and had higher vaccination coverage than all continents.

Table 1. COVID-19 statistics for the Gulf Cooperation Council countries by the end of 2020 (sorted according to the number of deaths per million).

	Oman	Kuwait	Bahrain	SA*	Qatar	UAE*
No. of cases	128,867	150,584	92,675	362,741	143,834	207,822
No. of deaths	1,499	934	352	6,223	245	669
CFR*	1.16%	0.62%	0.38%	1.72%	0.17%	0.32%
C/M*	24,924	35,004	53,557	10,340	51,226	20,887
D/M*	290	217	203	177	87	67
No. of tests	571,472	1,254,832	2,366,275	11,010,384	1,241,406	20,890,341
Tests/pop.	0.11	0.29	1.37	0.31	0.44	2.1
Population	5,106,626	4,270,571	1,701,575	34,813,871	2,881,053	9,890,402

* SA: Saudi Arabia, UAE: United Arab Emirates, CFR: Case-fatality rate, C/M: The number of cases per million, D/M: The number of deaths per million.

Table 2. COVID-19 statistics for the Gulf Cooperation Council countries by the end of 2021 (sorted according to the number of deaths per million).

	Bahrain	Oman	Kuwait	SA*	Qatar	UAE*
No. of cases	282,062	305,489	417,135	556,236	250,528	761,937
No. of deaths	1,394	4,116	2,468	8,877	618	2,164
CFR*	0.49%	1.35%	0.59%	1.60%	0.25%	0.28%
C/M*	157,601	57,636	95,566	15,614	89,226	75,672
D/M*	779	777	565	249	220	215
No. of tests	8,027,797	25,000,000	5,966,736	33,229,844	3,174,433	111,351,511
Tests/pop.	4.49	4.72	1.37	0.93	1.13	11.06
Vac.#	80.05%	75.35%	63.42%	63.7%	82.31%	95.96%
Population	1,789,718	5,300,353	4,364,880	35,623,404	2,807,805	10,068,883

* SA: Saudi Arabia, UAE: United Arab Emirates, CFR: Case-fatality rate, C/M: The number of cases per million, D/M: The number of deaths per million.
 # Vac.: The vaccination coverage rate (the percentage of people who complete the initial protocol) as of January 1, 2022.

Table 3. COVID-19 statistics for the Gulf Cooperation Council countries by the end of 2022 (sorted according to the number of deaths per million).

	Bahrain	Oman	Kuwait	SA*	UAE*	Qatar
No. of cases	698,737	399,154	662,747	827,004	1,046,918	489,428
No. of deaths	1,539	4,260	2,570	9,518	2,348	685
CFR*	0.22%	1.07%	0.39%	1.15%	0.22%	0.14%
C/M*	391,672	74,973	151,301	23,072	103,843	164,242
D/M*	863	800	587	266	233	230
No. of tests	10,633,110	25,000,000£	8,447,300	44,940,564	197,928,922	4,065,369
Tests/pop.	5.96	4.7	1.93	1.25	19.63	1.36
Vac.#	83.33%	66.62%	78.32%	69.63%	103.72%¥	105.75%¥
Population	1,783,983	5,323,993	4,380,326	35,844,909	10,081,785	2,979,915

* SA: Saudi Arabia, UAE: United Arab Emirates, CFR: Case-fatality rate, C/M: The number of cases per million, D/M: The number of deaths per million.
 # Vac.: The vaccination coverage rate (the percentage of people who complete the initial protocol) as of January 1, 2023.
£ Oman has not updated the number of tests performed in 2022.
¥ The rate exceeds 100% due to the vaccination of non-residents.

Table 4. COVID-19 statistics for the Gulf Cooperation Council countries compared to non-Gulf Cooperation Council Arab countries by the end of 2020, 2021, and 2022.

Table 4. COVID-19 statistics for the Gulf Cooperation Council countries compared to non-Gulf Cooperation Council Arab countries by the end of 2020, 2021, and 2022.

	End of 2020			End of 2021			End of 2022		
	GCC*	Non-GCC	All	GCC	Non-GCC	All	GCC	Non-GCC	All
No. of cases	1,086,523 (33.20%)	2,186,438 (66.80%)	3,272,961	2,573,387 (26.35%)	7,192,852 (73.65%)	9,766,239	4,123,988 (29.16%)	10,017,067 (70.84%)	14,141,055
No. of deaths	9,922 (17.52%)	46,721 (82.48%)	56,643	19,637 (12.66%)	135,451 (87.34%)	155,088	20,920 (12.09%)	152,178 (87.91%)	173,098
CFR*	0.91%	2.14%	1.73%	0.76%	1.88%	1.59%	0.51%	1.52%	1.22%
C/M*	18,402	5,735	7,434	42,922	18,518	21,781	68,284	25,486	31,186
D/M*	168	123	129	328	349	346	346	387	382
No. of tests	37,334,710 (68.14%)	17,456,393 (31.86%)	54,791,103	186,750,321 (75.57%)	60,359,491 (24.43%)	247,109,812	291,015,265 (80.27%)	71,527,361 (19.73%)	362,542,626
Tests/pop.	0.63	0.05	0.12	3.11	0.14	0.55	4.82	0.16	0.76
Population	59,042,566	381,252,179	440,294,745	59,955,043	388,419,318	448,374,361	60,394,911	393,042,209	453,437,120

* GCC: Gulf Cooperation Council, CFR: Case-fatality rate, C/M: The number of cases per million, D/M: The number of deaths per million.

Table 5. *Comparison of variance of means between the Gulf Cooperation Council countries and non-Gulf Cooperation Council Arab countries by the end of 2020, 2021, and 2022.*

	End of 2020			End of 2021			End of 2022		
	GCC*	Non-GCC	P value[#]	GCC	Non-GCC	P value[#]	GCC	Non-GCC	P value[#]
Mean CFR* ±SD*	0.73% ±0.60	3.32% ±6.85	.181	0.76% ±0.57	3.99% ±4.62	.109	0.53% ±0.46	3.56% ±4.39	.113
Mean C/M* ±SD	32,656 ±17,225	9,354 ±10,337	.81	81,886 ±46,888	28,571 ±33,227	.007[#]	151,517 ±128,426	48,969 ±61,492	.018[#]
Mean D/M* ±SD	174 ±84	148 ±135	.047[#]	468 ±274	540 ±595	.781	497 ±293	609 ±687	.706
Mean tests/pop. ±SD	0.77 ±0.79	0.12 ±0.10	.000[#]	3.95 ±3.88	0.29 ±0.36	.001[#]	5.81 ±7.04	0.32 ±0.44	.006[#]
Mean Vac.* ±SD	-			76.80% ±12.34	20.10% ±17.79	.000[#]	84.56% ±16.74	30.72% ±16.55	.000[#]

* GCC: Gulf Cooperation Council, CFR: Case-fatality rate, SD: Standard deviation, C/M: The number of cases per million, D/M: The number of deaths per million, Vac.: The vaccination coverage rate (the rate of people who complete the initial protocol) by the end of the year indicated.
 # Independent-samples t-test: A p-value of < 0.05 is considered significant.

Table 6. *COVID-19 statistics among the six continents by the end of 2022 (sorted according to the number of deaths per million).*

	S. America (N=14)	Europe (N=48)	N. America* (N=39)	Oceania (N=20)	Asia (N=50)	Africa (N=58)	All (N=229)
No. of cases	66,894,821 (10.06%)	243,017,738 (36.55%)	121,375,713 (18.26%)	13,632,412 (2.05%)	207,176,629 (31.16%)	12,741,754 (1.92%)	**664,839,788**
No. of deaths	1,342,032 (20.04%)	1,981,883 (29.59%)	1,578,962 (23.58%)	23,386 (0.35%)	1,512,322 (22.58%)	258,344 (3.86%)	**6,696,944**
CFR[#]	2.01%	0.82%	1.30%	0.17%	0.73%	2.03%	**1.01%**
Mean CFR¥ ±SD[#]	1.80% ±1.25	0.91% ±0.84	1.08% ±0.89	0.32% ±0.41	1.40% ±2.63	1.92% ±1.69	**1.30% ±1.68**
C/M[#]	152,835	325,088	202,922	313,602	88,222	9,058	**83,681**
Mean C/M ±SD	182,601 ±135,607	383,709 ±180,346	223,406 ±164,002	212,096 ±150,483	150,298 ±168,769	41,622 ±103,225	**191,521 ±192,320**
D/M[#]	3,066	2,651	2,640	583	321	184	**843**
Mean D/M ±SD	2,339 ±1,553	2,609 ±1,234	1,477 ±838	421 ±551	675 ±761	324 ±523	**1,222 ±1,265**
No. of tests	241,010,791 (3.50%)	2,807,811,408 (40.79%)	1,287,843,307 (18.71%)	88,449,531 (1.28%)	2,348,358,629 (34.11%)	109,824,594 (1.60%)	**6,883,298,260**
Tests/pop.	0.55	3.76	2.15	2.03	0.50	0.08	**0.87**
Mean test/ pop. ±SD	0.99 ±0.85	4.50 ±5.13	2.66 ±3.54	1.46 ±1.53	1.92 ±3.37	0.21 ±0.31	**2.08 ±3.58**
Vac. [#]	77.42%	66.41%	65.47%	61.96%	72.42%	27.54%	**63.41%**
Population	437,694,443	747,543,837	598,140,916	43,470,408	4,711,356,783	1,406,728,744	**7,944,935,131**

* North America includes Mexico and Caribbean countries.
 # CFR: Case-fatality rate, SD: Standard deviation, C/M: The number of cases per million, D/M: The number of deaths per million, Vac.: The vaccination coverage rate (the rate of people who complete the initial protocol) by the end of 2022.
¥ The mean is the sum of all values in the data set divided by the total number of values. While the CFR (not mean CFR), for example, is the total number of deaths of all countries included/the total number of cases in the same countries.

Discussion.

It has been nearly three years since the emergence of SARS-CoV-2. A thorough understanding of the epidemiology of COVID-19 is crucial to enable comparison of the pandemic across countries. All countries and territories have reported cases of COVID-19 except Turkmenistan [2,15]. However, governments and health authorities offer varying procedures while registering and reporting their data. Most of the bias in those procedures is influenced by economic and political pressures and may lead to intentional or unintentional data corruption, which can hide crucial information [16]. In particular, the epidemiology was inconsistent among Arab countries, as a previous study showed [10], where Arab countries in Africa were less affected and less tested than those in Asia (the GCC countries belong to Arab countries in Asia). The current study discovers other differences in statistics between the GCC countries and other Arab countries. During the three years, the GCC countries recorded cases of infection per million, at least twice as many as those recorded by non-GCC Arab countries. Statistically, the number of COVID-19 cases is proportional to the number of tests performed [17].

As of January 1, 2023, 6,883,298,260 tests had been performed worldwide. Detecting cases of COVID-19 and thus attributing deaths to SARS-CoV-2 depends on the testing

availability. Looking at the global testing strategy contributes to understanding the reasons for the massive number of tests being performed. Besides the diagnostic testing strategy, screening asymptomatic people who do not have known, suspected, or reported exposure to SARS-CoV-2 is another strategy followed globally to control the community spread of the virus [18]. In the GCC countries, the higher number of cases per million recorded can be explained by the significant rate of testing performed. Due to their economic strength, these countries have performed tests nearly five times more than their entire population. Put another way, unlike other Arab countries (except Jordan), each GCC country has performed tests more than its population. During the COVID-19 pandemic, mass screening was followed to fight against SARS-CoV-2 and return to normalcy [19]. Therefore, mass testing campaigns were conducted in the GCC countries, especially in 2021 and early 2022.

Although the oil-rich GCC countries have similar socioeconomic issues, environmental conditions, and healthcare capacities and have implemented nearly the same measures to control the spread of SARS-CoV-2, COVID-19 statistics were somewhat inconsistent across the six GCC countries, which is consistent with other studies [20,21]. To illustrate, the number of cases per million ranged from 23,072 in SA to 391,672 in Bahrain (approximately 17 times larger) by the end of 2022. Similarly, there was high variability in the CFR, the number of deaths per million, and the tests per population. SA was the least GCC country performing tests per population, while the UAE performed tests nearly 20 times more than its population. So, SA had fewer cases relative to the population, making the CFR high. However, the CFR is not a suitable parameter to reflect the actual burden of disease/infection as it only considers part of the population (those with a positive test) [22]. The more testing is done, the more cases are detected, leading to more cases with mild disease and thus lowering the CFRs. Furthermore, statistics could be inconsistent in the same country. For example, in SA, despite applying the same restrictions and preventive measures across all cities, the incidence of COVID-19 was uneven across different cities [23].

For global comparison, the GCC countries have suffered less from the pandemic and have performed more tests relative to their population (see Tables 4-6), which is consistent with other studies [8,21]. Alternately, if we compare the GCC countries as a group to the world countries, we will find that they rank 150 among the 229 countries/territories based on the number of deaths per million. Across continents, Asia, where the epidemic originated, was less affected, taking into account the huge population size of the continent. Another surprising note is that Qatar, which hosted the World Cup from November 20 to December 18, 2022, recorded approximately 10 thousand cases, with one death during this period [2]. In contrast, China, which was following the zero-COVID-19 policy [24], has suffered from a third wave [25].

On the other hand, the difference in median age between countries is a possible factor affecting COVID-19 statistics; the GCC countries have a higher median age than non-GCC Arab countries. However, in contrast to the number of cases per million, there was no significant difference in the number of deaths per million between the GCC and non-GCC countries. One study showed that the median age in African countries was proportional to the number of cases per million, the number of deaths per million, and the number of tests, but not among European countries [4]. Because of the limited capacity for testing in Africa, it seems that the testing was limited to the elderly [4]. Nevertheless, between countries and across continents, the number of COVID-19 cases/deaths/tests and the CFR vary significantly and over time, suggesting considerable uncertainty over the exact COVID-19 statistics worldwide. The most important reason for this variability is the difference between countries in terms of the definition of suspected cases, testing strategies, the criteria for when a result is considered positive, the capacity to perform testing, reporting methods, and politics [4,11,16,17].

Over the three years, the impact of the COVID-19 pandemic has been variable worldwide. The second year was the worst, as the number of cases and deaths tripled. The same almost happened in the GCC region. In contrast, the world in 2022 witnessed the most negligible impact. Despite the dramatic rise in cases in 2022, there has been no similar rise in the number of deaths. In the GCC countries, there were 1,550,601 cases and 1,283 deaths in 2022, representing 37.60% and 6.13% of all cases and deaths since the start of recording COVID-19 data, respectively. Moreover, most of these cases (66%) and deaths (68%) occurred in the first six months [10]. Many factors affect the course of the pandemic over time; natural and vaccine-induced immunity are among them.

Regarding vaccine-induced immunity, the vaccination coverage rate in the GCC countries was excellent; an average of about 85% of people have been fully vaccinated. The GCC countries are classified among the high-income economy based on the World Bank [26]; this possibly justifies the higher vaccination coverage in these countries compared to other Arab countries. In the previous study, which examined COVID-19 statistics in the Arab world, vaccination coverage was negatively associated with CFRs and positively with the number of tests, the number of tests per million, and the number of cases per million [10]. Countries with high vaccination coverage (as the GCC countries) seem to have active COVID-19 testing programs and therefore have more cases. Another study, including 191 countries, showed that vaccination is directly proportional to the number of cases detected and negatively to CFRs [27]. However, the higher vaccination rate cannot explain the lower mortality rate. This is not a general phenomenon; many countries had a low vaccination rate but were affected less. For example, Yemen, Somalia, Sudan, Algeria, Syria, and Djibouti were the least affected Arab countries according to the number of deaths per million (<200). At the same time, these countries were among the least vaccinated Arab countries (the vaccination coverage was <30%) [10].

Furthermore, the natural immunity acquired during the three years plays an essential role in mitigating the virulence of the virus [28]. Most people infected with SARS-CoV-2 develop a natural immunity of both cell-mediated and humoral type,

which is effective over time and protects against reinfection and severe illness, while vaccine-induced immunity decays faster than natural immunity [28]. By the end of 2022, it is estimated that at least 6.6 billion infections with SARS-CoV-2 have occurred worldwide [29]. Therefore, unless the end of the pandemic is announced, the health authorities of the GCC need to reconsider the definition of a suspected case of COVID-19 and apply more specific criteria. Unfortunately, clinical features of COVID-19 include almost every respiratory symptom/ sign and nearly every general symptom/sign, as well as some gastrointestinal symptoms [30,31]. So, since pneumonia is the most severe frequent manifestation of SARS-CoV-2 [1,31], it is appropriate that the requirements of the suspect case of SARS-CoV-2 disease must include lower respiratory symptoms, such as dyspnea, with abnormal vital signs and chest X-ray abnormalities suggestive of pneumonia, as well as a history of contact with a probable or confirmed case of COVID-19, not only upper respiratory tract symptoms. Otherwise, more mild/ asymptomatic cases of COVID-19 will continue to appear, especially in the cold seasons.

Finally, this study provides an updated overview of COVID-19 statistics in the GCC countries and how much they differ from non-GCC Arab countries and globally. However, there are some limitations to this study. The most important limit is that the quality of information obtained depends on the raw data quality. Not all countries report COVID-19 statistics at the same frequency and quality. For example, while data on tests per population are instructive in demonstrating increasing testing capacity, it is unknown whether some countries record the number of people tested or the total number of tests performed, as some persons may require more tests to obtain accurate results. Moreover, some countries have recently begun not updating their data on COVID-19 as they used to.

Conclusion.

By the end of 2022, the GCC countries have been less affected by the COVID-19 pandemic when compared globally. However, COVID-19 statistics vary across the GCC countries, especially regarding the number of tests performed. Moreover, the statistics were inconsistent between the GCC countries and non-GCC Arab countries. Fortunately, the average COVID-19 vaccination coverage in the GCC countries was higher than the global one. So, given the natural immunity acquired during the three years and the excellent vaccine coverage in the GCC countries, it is appropriate that the requirements of the suspect case of SARS-CoV-2 disease must include lower respiratory symptoms, such as dyspnea, with abnormal vital signs and chest X-ray abnormalities suggestive of pneumonia, as well as a history of contact with a probable or confirmed case of COVID-19, not only upper respiratory tract symptoms.

Finally, unless the end of the pandemic is announced, a better understanding of the epidemiology of COVID-19 needs further and updated studies, as COVID-19 statistics are very dynamic. Moreover, the situation is more complex because of the interaction of several complicated factors.

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