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Comparative Global Epidemiological Investigation of SARS-CoV-2 and SARS-CoV Diseases Using Meta-MUMS Tool Through Incidence, Mortality, and Recovery Rates

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COVID-19 is a novel coronavirus that was reported by the world health organization in late December 2019. As an unexplained respiratory disease epidemic, which is similar to respiratory syndrome coronavirus SARS-CoV, it rapidly spread all over the world. The study aims to compare several parameters of COVID-19 and SARS-CoV infectious diseases in terms of incidence, mortality, and recovery rates. The publicly available dataset Worldometer (extracted on April 5, 2020) confirmed by WHO report was available for meta-analysis purposes using the Meta-MUMS tool. And, the reported outcomes of the analysis used a random-effects model to evaluate the event rate, and risk ratios thorough subgroup analysis forest plots. Seventeen countries for COVID-19 and eight countries of SARS infections, including COVID-19 group $n = 1124243$, and SARS-CoV group $n = 8346$, were analyzed. In this meta-analysis, a random effect model of relations of incidence, mortality, and recovery rates of COVID-19 and SARS world infections were determined. The meta-analysis and forest plots of two viral world infections showed that the incidence rate of COVID-19 infection is more than SARS infections, while recovery and mortality event rates of SARS-CoV are more than COVID-19 infection. And subgroup analysis showed that the mortality and recovery rates were higher in both SARS-CoV wand COVID-19 in comparison to incidence and mortality rates, respectively. In conclusion, the meta-analysis approach on the abovementioned dataset revealed the epidemiological and statistical analyses for comparing COVID-19 and SARS-CoV outbreaks.

Key Words: COVID-19, SARS-CoV, Meta-analysis, Meta-MUMS, Epidemiology.

Introduction

The world health organization (WHO) reported the severe acute respiratory syndrome coronavirus-2 known as COVID-19 in late December 2019 in China. As of April 5, 2020, based on the WHO report (i.e., https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports), the numbers of laboratory-confirmed cases and mortalities were 1133758? and 62784?, respectively. Moreover, the sequence similarity scores of COVID-19 with Bat SARS-like, SARS-CoV, and MERS-CoV were about 99, 96, and 50%, respectively (1).

Epidemiologically, the COVID-19 outbreak has spread to more than 200 countries resulting in WHO risk assessment status as ‘‘very high’’. For this purpose, several authors have recently carried out their researches on COVID-19, which

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were mostly based on clinical and epidemiological views and included the potential symptoms, the ways of COVID-19 transmission, and epidemic issues (2). Among them, Hellewell et al. proposed a stochastic transmission model that resulted in the case and contact isolations to control the COVID-19 outbreak (3). Moreover, Peeri et al. compared the epidemics of three types of coronaviruses, namely SARS, MERS, and COVID-19. They concluded that there were no frequent outbreaks found from two previous ones, and the challenges for the COVID-19 should be covered by the applications of the Internet of Things (IoT), which will be beneficial for control the incidence among people (4). Two systematic reviews and meta-analysis studies were available in the literature. They proposed five useful factors (i.e., clinical, laboratory, imaging features, procalcitonin measurements, outcomes of confirmed cases) in predicting the severity of the COVID-19 disease (5−7).

In the current study, the comparisons between incidence and mortality, as well as recovery and death rates among the countries for COVID-19 and SARS-CoV with the higher incidence rates, were performed using the meta-analysis approach developed in the Meta-MUMS tool. The statistical analyses used both subgroup forest plots using event rate and risk ratio statistics.

Materials and Methods

Data Sources

Data for meta-analysis could be extracted from open datasets (8). The original and well-known data resources for COVID-19 were World Health Organization (WHO), i.e., https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports, and Worldometers, i.e., https://www.worldometers.info/coronavirus/. The retrieved parameters for the countries to be meta-analyzed were total sample size, cumulative confirmed cases, cumulative mortalities, and total recovered cases; And, the data for high-risk countries in terms of incidence related to COVID-19 was extracted up to April 5, 2020. Moreover, the summary table of SARS-CoV was available from https://www.who.int/csr/sars/country/country2003_08_15.pdf?ua=1 for the period November 16, 2002−August 7, 2003.

Statistical Analysis

The analysis environment was the Meta-MUMS tool as a comprehensive meta-analysis tool without any limitations in number size and data entry (9,10). Analysis of dichotomous data was done with a 95% confidence interval to set lower and upper limits based on risk ratio (RR) as well as event rate (ER) when no interventions are involved (11). In all calculations and analyses, the *p*-values less than 0.05 were statistically significant.

The evaluation of heterogeneity between the analyzed countries was by calculating the I^2 test and Cochrane's Q test. And, whenever a significant heterogeneity was present, a random-effects model was used; otherwise, we utilize a fixed-effects model. Additionally, subgroup analysis was carried out among the target countries to compare the effect sizes of "incidence vs. mortality" and "recovery vs. mortality" using risk ratio. And, subgroup analysis was performed for comparing effect sizes of incidence, mortality, and recovery rates using event rate.

Results and Discussion

In the current meta-analysis, $n = 1124243$ patients of COVID-19 infection, and $n = 8346$ of SARS-CoV were available and retrieved from the initial research of WHO and Worldometer freely accessible databases. The "incidence vs. mortality" and "recovery vs. mortality" ratios are also determined. Indeed, subgroup analyses were also performed for evaluation of learning significant differences of ER and RR.

Event rates of incidence, recovery, and mortality of COVID-19, and SARS-CoV infections are as the following:

The incidence event rates of COVID-19 and SARS-CoV infections are as below, and the forest plots are illustrated in Figure 1A, showing the relationships between two infectious diseases.

$$\text{Logit ER} = -7.257,\ \text{LL} = -7.768,\ \text{UL} = -6.747,\ p < 0.001$$

$$\text{Logit ER} = -12.303,\ \text{LL} = -13.910,\ \text{UL} = -10.695,\ p < 0.001$$

So, the incidence rate of COVID-19 is more than SARS-CoV ($p < 0.001$) and the same outcomes apply to the cumulative incidence rates with ($p < 0.001$).

The mortality event rates of COVID-19 and SARS-CoV infections are as follows, where the forest plots Figure 1B shows the relationships between two viral diseases.

$$\text{Logit ER} = -3.113,\ \text{LL} = -3.439,\ \text{UL} = -2.786,\ p < 0.001$$

$$\text{Logit ER} = -1.914,\ \text{LL} = -2.515,\ \text{UL} = -1.312,\ p < 0.001$$

The mortality rate of SARS-CoV infection is more than COVID-19 infection ($p < 0.001$), by also considering their cumulative mortality rate with $p < 0.001$.

Recovery event rate of COVID-19 and SARS-CoV infections are as below, and the forest plots are illustrated in Figure 2A, showing the relations between both diseases.

$$\text{Logit ER} = -1.913,\ \text{LL} = -2.4675,\ \text{UL} = -1.359,\ p < 0.001$$

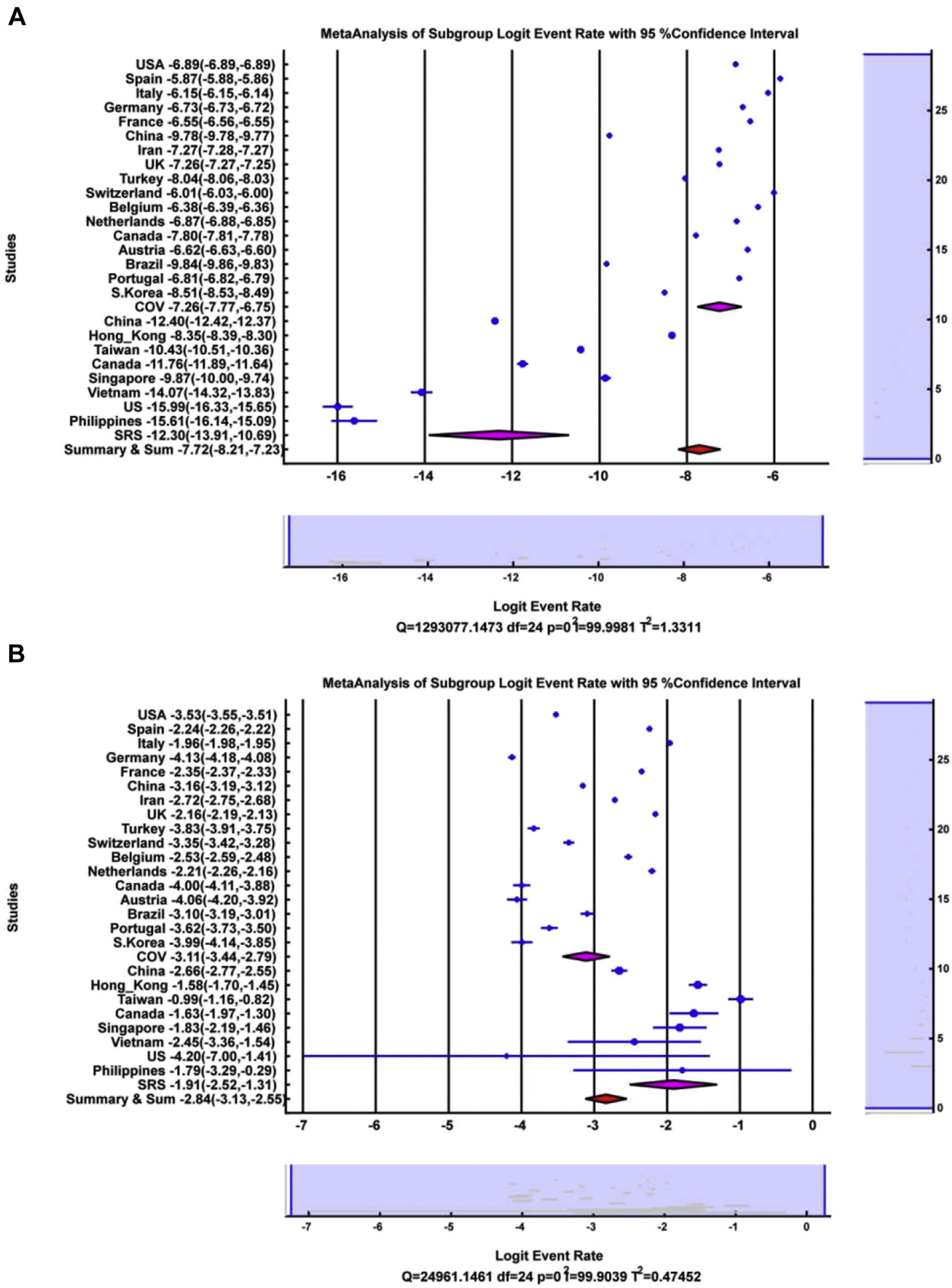

Figure 1. (A) Forest plot for Logit event rate statistics of incidence of COVID-19 and SARS-CoV, (B) Forest plot for Logit event rate statistics of mortality of COVID-19 and SARS-CoV.

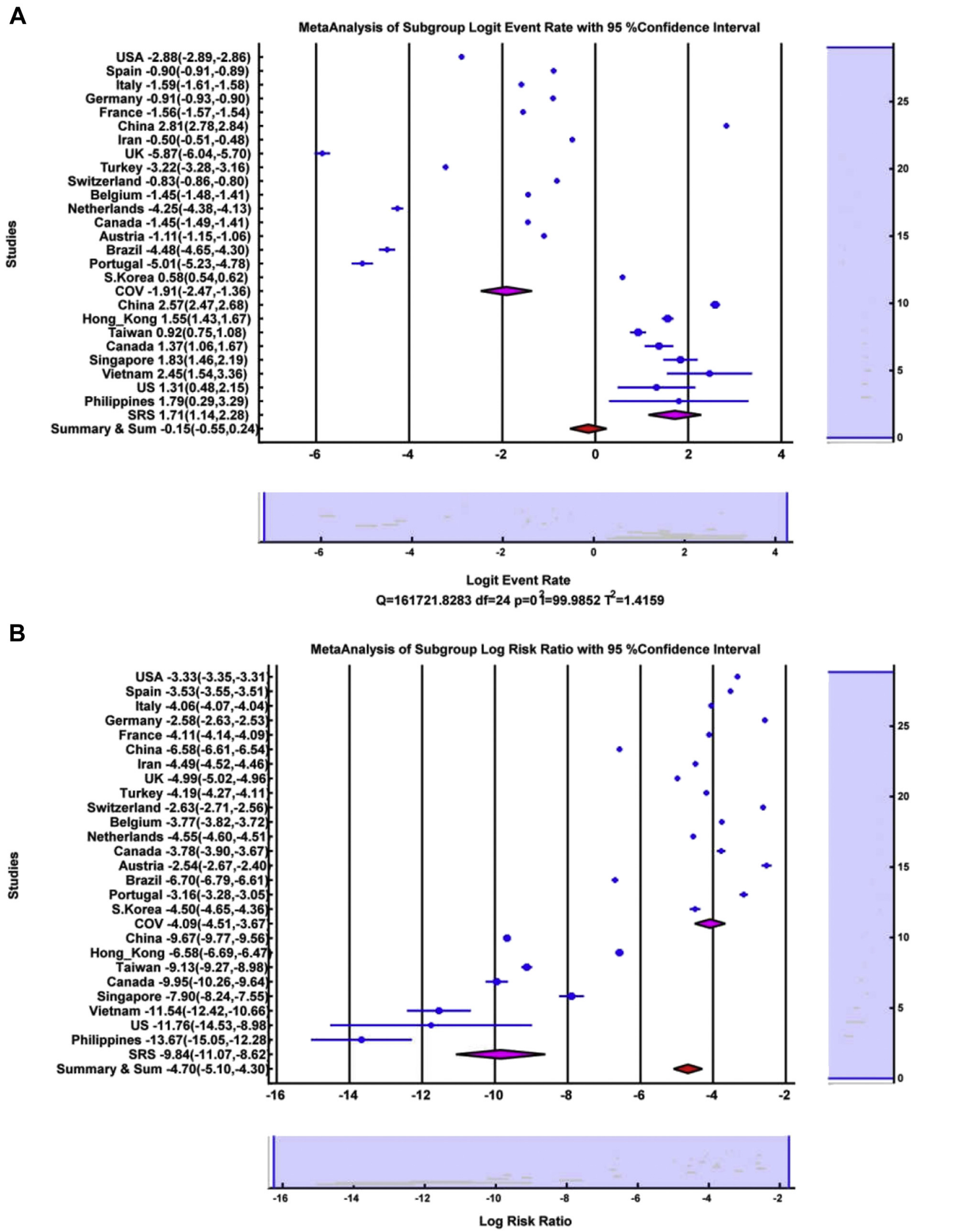

Figure 2. (A) Forest plot for Logit event rate statistics of recovery of COVID-19 and SARS-CoV, (B) Forest plot for Logit event rate statistics of incidence vs. mortality of COVID-19 and SARS-CoV.

$$\text{Logit ER} = 1.706,\ \text{LL} = 1.137,\ \text{UL} = 2.276,\ p < 0.001$$

So, the recovery rate of SARS-CoV infection is more than COVID-19 infection ($p < 0.001$) with the same results using the cumulative recovery rate with $p < 0.001$.

Incidence vs. mortality results of COVID-19 and SARS-CoV infections are as below. The forest plots illustrated in Figure 2B show the relations between the two diseases.

$$\text{Log RR} = -4.089,\ \text{LL} = -4.512,\ \text{UL} = -3.666,\ p < 0.001$$

$$\text{Log RR} = -9.845,\ \text{LL} = -11.074,\ \text{UL} = -8.615,\ p < 0.001$$

And, the mortality rate is higher than the incidence rate in both infection groups, and subgroup analysis showed that in SARS infection, the mortality rate is more than incidence rate in comparison to COVID-19 disease ($p < 0.001$). Cumulative incidence vs. mortality rateof COVID-19 and SARS-CoV infections reflected the above results with $p < 0.001$.

Recovery vs. mortality results of COVID-19 and SARS-CoV infections are as below. The forest plots are illustrated in Figure 3, showing the relations between the two diseases.

$$\text{Log RR} = 0.867,\ \text{LL} = 0.389,\ \text{UL} = 1.345,\ p < 0.001$$

$$\text{Log RR} = 1.895,\ \text{LL} = 1.300,\ \text{UL} = 2.489,\ p < 0.001$$

Which resulted, the recovery rate is more than the mortality rate in both infectious groups, And subgroup analysis has shown that in SARS infection, the recovery rate vs. mortality rate is higher than that of COVID-19 ($p < 0.008$). And, cumulative recovery rate vs. mortality rate of COVID-19 and SARS-CoV infections reflected the above results with $p < 0.001$.

Some recent news reported that the COVID-19 has more mortality rate than the combination of SARS and MERS (12). However, one should note that, while this comes to statistical analysis, the whole population of the world and countries are essential factors.

The rapid virus spread, known as also super spreading people, played a vital role in previous SARS-CoV (case fatality rate of 9.6%) and MERS (case fatality rate of about 38%) outbreaks, and also needs special attention in COVID-19 as well (13).

In summary, we demonstrated the statistical analyses of incidence, mortality, and recovery rates between COVID-19 and SARS-CoV, along with their subgroups analysis.

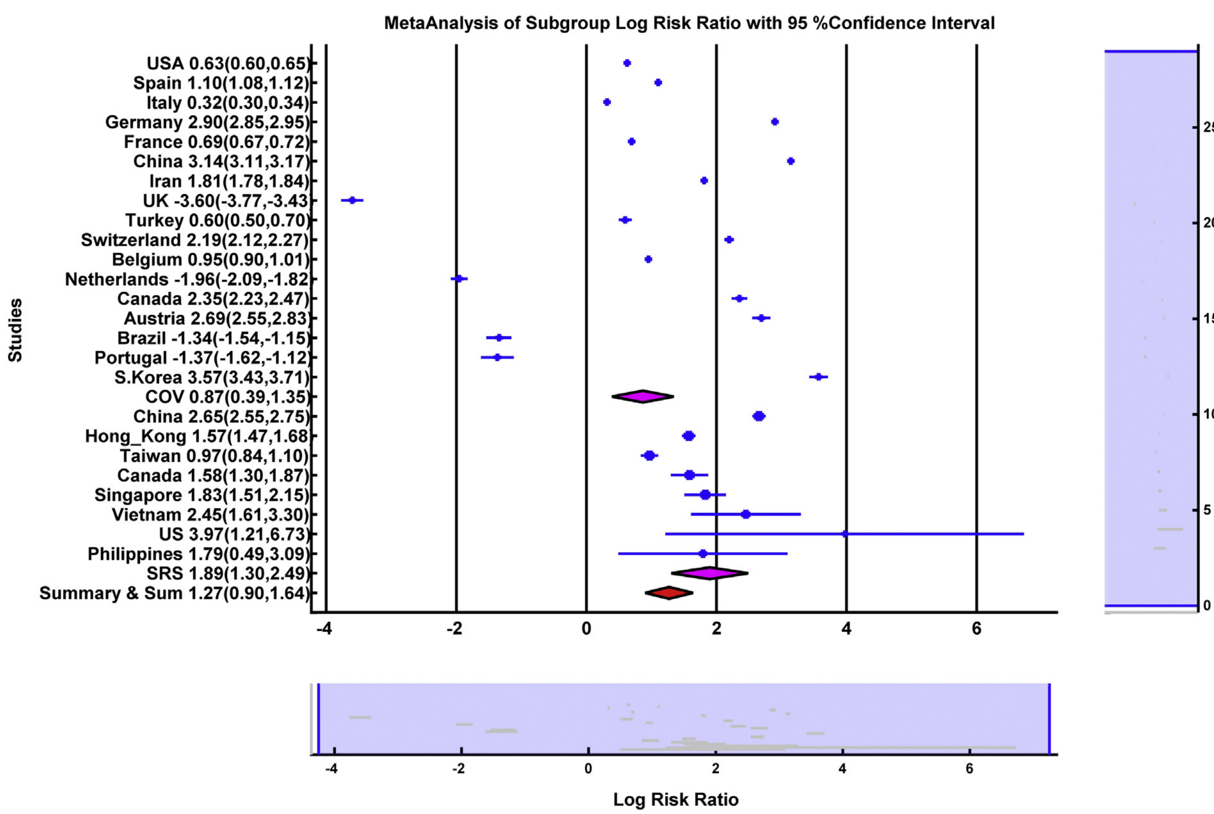

Figure 3. Forest plot for Logit event rate statistics of recovery vs. mortality of COVID-19 and SARS-CoV.

And, hopefully, this would shed more evidence in controlling the new infectious disease.

The limitations of the current meta-analysis are as below:

- The use of open datasets.
- All data were observational numbers reported for incidence, mortality, and recovery values.
- Only the countries with higher incidence values (those which are high-risk countries based on WHO criteria assessment) are involved in the current meta-analysis, which might be influenced by selection bias in the future.
- Due to the nature of the meta-analysis, the evaluation of publication bias was not possible.

Conclusions

The current meta-analysis provided more information on incidence, mortality, and recovery rates between COVID-19 and SARS-CoV infectious diseases. Based on event rate evaluation, the incidence rate of COVID-19 was higher than SARS-CoV's where mortality and recovery rates for SARS-CoV were higher in comparison with COVID-19. On the other hand, the risk ratio and subgroup analysis of ''incidence vs. mortality'' and ''recovery vs. mortality'' for both COVID-19 and SARS-CoV revealed new findings. Those were the higher mortality and recovery rates of both SARS-CoV and COVID-19 in comparison to incidence and mortality rates, respectively.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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