Risk of Mortality in Patients with Comorbidities and Covid-19 in Some parts of Africa

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***Abstract* — One of the most conspicuous developmental challenge in Africa is the health and disease burden. Africa faces more health challenges compared to other regions in the world. This poses a threat to the economic development. The Covid-19 pandemic is projected to have one of its worst consequences in Africa especially in patients with comorbidities. The data for this research was sourced via Google scholar, PubMed and Medline. A Meta-analysis was conducted with 8 studies and analyzed using the comprehensive Meta-analysis software. The resulting summary effect for the random effect was 1.886 at 95% confidence interval of (1.40,2.53), I-square =92.7%, (p-value =0.000). The result of this study favors mortality, therefore, implementation of adequate protection and interventions for covid-19 patients and particularly those with comorbidities may significantly reduce the risk of mortality associated with Covid-19.**

Keywords – *Meta-analysis, Covid-19, Comorbidities, Mortality*

I. Introduction

Corona virus disease also known as COVID-19 is caused by an infection with severe acute respiratory syndrome Corona virus -2 (SARS-COV-2) which was first identified in Wuhan, China in December 2019.The Corona virus disease outbreak was declared a public health emergency by the world health organization (WHO) (https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200401-sitrep-72-covid-19.pdf?sfvrsn=, 2019); the outbreak of the corona virus disease infected more than five (5) million people, caused more than 324,000 deaths and had about 1.7 million (Adehi M. U., 2017) recoveries worldwide within its first six months (https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200401-sitrep-72-covid-19.pdf?sfvrsn=, 2019).

The corona virus disease was first confirmed to have spread to Africa on the 14th February 2020 with its first case in Egypt. The first case in Sub-Saharan Africa was announced in Nigeria at the end of February 2020. Within 3 months, the virus had spread throughout the continent. As of 19th November 2021, statistics from world meters shows that Africa has 8,652,178 confirmed cases, 396,350 active cases, 8,033,858 recoveries and 221,870 deaths (Worldometer- real time world statistics).

The challenge of Covid-19 is very high globally due to the complexity of its transmission and lack of proven treatment. Its impact in Africa remains markedly low but it is viewed that Africa may still have some of its worst consequences of Covid-19 pandemic due to poor health systems and this remains a source of concern particularly in the event of an increase in outbreaks. Evidence from global outbreak of COVID-19 has shown that patients with comorbidities such as Obesity, Hypertension, Diabetes and Cancer are known to have risk of mortality. Infectious diseases such as HIV and Tuberculosis are highly prevalent in Africa and are known to affect the immune function which may in turn affect immune response to COVID-19.

To perform a meta-analysis, we have to find an effect size which can be summarized across all studies. Sometimes such effect size can be directly extracted from publications while other times it needs to be calculated from other data reports in the studies. The selected effect size can have a substantial impact on the results of meta-analyses and their interpretations.
Effect sizes can be measured in two of several ways (Michael Borenstien, 2009).

1. It can be measured as the standard difference between two means
2. It can be measured as the correlation between the independent variable classification and individual scores on the dependent variable

(Farha Musharrat Noor, 2020) conducted a meta-analysis to investigate the prevalence of mortality amongst hospitalized covid-19 patients revealed that old age, gender, ICU patients, patients with comorbidity had a high risk for fatality cases. A meta-analysis conducted involving 58 studies with 122,191 patients were analyzed. A significant association was found between mortality amongst covid-19 infected patients and older (>65 years) [RR 3.359, 95% CI 1.87-6.90, p< 0.001], Gender (male vs female) [RR 1.63,95% CI 1.43- 1.87, P<0.001], ICU admitted patients [RR 3.72, 95% CI 2.70- 5.13, P<0.01], obesity; [RR 2.18, 95% CI 1.1.-4.34, P< 0.05] hypertension [RR 2.08, 95% CI 1.79 -2.43, P< 0.001] diabetes [RR 1.87, 95% CI 1.23-2.84, P<0.01] Cardiovascular diseases [RR 2.5 95%,1.20-5.26, p<0.05. In addition, high risk of mortality was also found for cerebrovascular diseases, COPD, chronic renal, lung and heart diseases.
(Ssentongo P., 2020) conducted a meta-analysis to investigate the risk of COVID-19 mortality in patients with and without pre-existing comorbidities.11 comorbidities were analyzed: cardiovascular diseases, hypertension, diabetes, congestive heart failure, cerebrovascular disease, chronic kidney disease, chronic liver disease, cancer, chronic obstructive pulmonary disease, asthma, and HIV/AIDS. All analyses were performed using random-effects models and heterogeneity was quantified. Eleven pre-existing comorbidities from 25 studies were included in the meta-analysis (n = 65, 484 patients with COVID-19; mean age; 61 years; 57% male). Overall, the between-study heterogeneity was medium, and studies had low publication bias and high quality. Cardiovascular disease (risk ratio (RR) 2.25, 95% CI = 1.60–3.17, number of studies (n) = 14), hypertension (1.82 [1.43 to 2.32], n = 13), diabetes (1.48 [1.02 to 2.15], n = 16), congestive heart failure (2.03 [1.28 to 3.21], n = 3), chronic kidney disease (3.25 [1.13 to 9.28)], n = 9) and cancer (1.47 [1.01 to 2.14), n = 10) were associated with a significantly greater risk of mortality from COVID-19. In conclusion, Patients with COVID-19 with cardiovascular disease, hypertension, diabetes, congestive heart failure, chronic kidney disease and cancer have a greater risk of mortality compared to patients with COVID-19without these comorbidities. Tailored infection prevention and treatment strategies targeting this high-risk population might improve survival.

II. METHODOLOGY

The systematic review and Meta-Analysis is aimed at investigating the risk of mortality in patients with comorbidities and covid-19 in Africa using the random effect meta-analysis.
All relevant articles were searched using the following databases; Google Scholar, PubMed, Medline and Cochrane library. All searches were limited to articles written about risk of mortality due to corona virus and other comorbidities in Africa. Search for scientific publications were done with the following keywords; Corona virus, Meta-analysis, Mortality and Comorbidities.
The method employed for this study is the Random effect model Meta-Analysis and analyzed using the Comprehensive Meta-Analysis software version 3 (CMF)

In this meta-analysis estimates were pooled via Random Effects Model (REM) using DerSimonian-Liard (DL) method when heterogeneity is significant. Fixed Effect Model (FEM) is utilized through Inverse variance (IV) method when the level of heterogeneity is not significant (Michael Borenstein, 2010) and applied in (Adehi M. U., 2017). To compute the study's variance under the random-effects model, we need to determine both the within-study variance and τ^2, since the study's total variance is the sum of the two values. One method for estimating τ^2 is the method of moments (or the DerSimonian and Laird) method (Rebecca DerSimonian, 2015). The parameter τ^2 (tau-squared) is the between studies variance (the variance of the effect size parameters across the population of studies).

The estimate of τ^2 is denoted by T^2,

$$T^2 = \frac{Q - df}{C} \quad (1)$$

where

$$Q = \sum_{i=1}^{k} W_i Y_i^2 - \frac{\left(\sum_{i=1}^{k} W_i Y_i\right)^2}{\sum_{i=1}^{k} W_i} \quad (2)$$

df=k-1

where k is the number of studies, and

$$C = \sum_{i=1}^{k} W_i - \frac{\sum_{i=1}^{k} W_i^2}{\sum_{i=1}^{k} W_i} \quad (3)$$

under the random-effects model the weight assigned to each study is

$$W_i = {}^{1}\!/\!_{Var(Y_i)} \quad (4)$$

where $Var(Y_i) = V_{Y_i}^*$ is the within-study variance from study i plus the between-study variance, τ^2.

$$V_{Y_i}^* = V_{Y_i} + T^2$$

The weighted mean, M^*, is

$$M^* = \frac{\sum_{i=1}^{k} W_i^* Y_i}{\sum_{i=1}^{k} W_i^*} \quad (5)$$

that is, the sum of the products (effect size multiplied by weight) divided by the sum of the weights.
The variance of the summary effect is estimated as the reciprocal of the sum of the weights, or

$$V_{M^*} = \frac{1}{\sum_{i=1}^{k} W_i^*} \quad (6)$$

and the estimated standard error of the summary effect is the square root of the variance,

$$SE_{M^*} = \sqrt{V_{M^*}} \quad (7)$$

The 95% lower and upper limits for the summary effect is

$$LL_{M^*} = M^* - 1.96 \times SE_{M^*} \quad (8)$$

and

$$UL_{M^*} = M^* + 1.96 \times SE_{M^*} \quad (9)$$

a Z-value to test the null hypothesis that the mean effect μ is zero is computed as

$$P^* = 1 - \phi\left(\pm\left|Z^*\right|\right)$$

where we choose '+' if the difference is in the expected direction or '- 'otherwise.
For a two-tailed test by

$$P^* = 2\left[1 - \left(\phi\left(\left|Z^*\right|\right)\right)\right]$$

where $\phi\left(\left|Z^*\right|\right)$ is the standard normal cumulative distribution.
The I^2- Statistic is an alternative and stronger measure compared to the Q- measure in (2)

$$I^2 = \left(\frac{Q - df}{Q}\right) \times 100\% \quad (10)$$

use value of Q from (2).
$0 \le I^2 < 25\%$ indicates low heterogeneity.
$25\% \le I^2 < 50\%$ indicates moderate heterogeneity.
$I^2 \ge 50\%$ indicates high heterogeneity.

II. Applications

Following the data extraction, systematic review and meta-analysis carried out using the Comprehensive Meta-Analysis Software, 12 studies were assessed for eligibility to evaluate the risk of mortality in patients with Corona virus and comorbidities in Africa. It was analyzed with the comprehensive meta-analysis software. Only 8 studies were included in the final quantitative meta-analysis and a total of 36,327,965 patients were included in the study.

Table 1: Forest plot

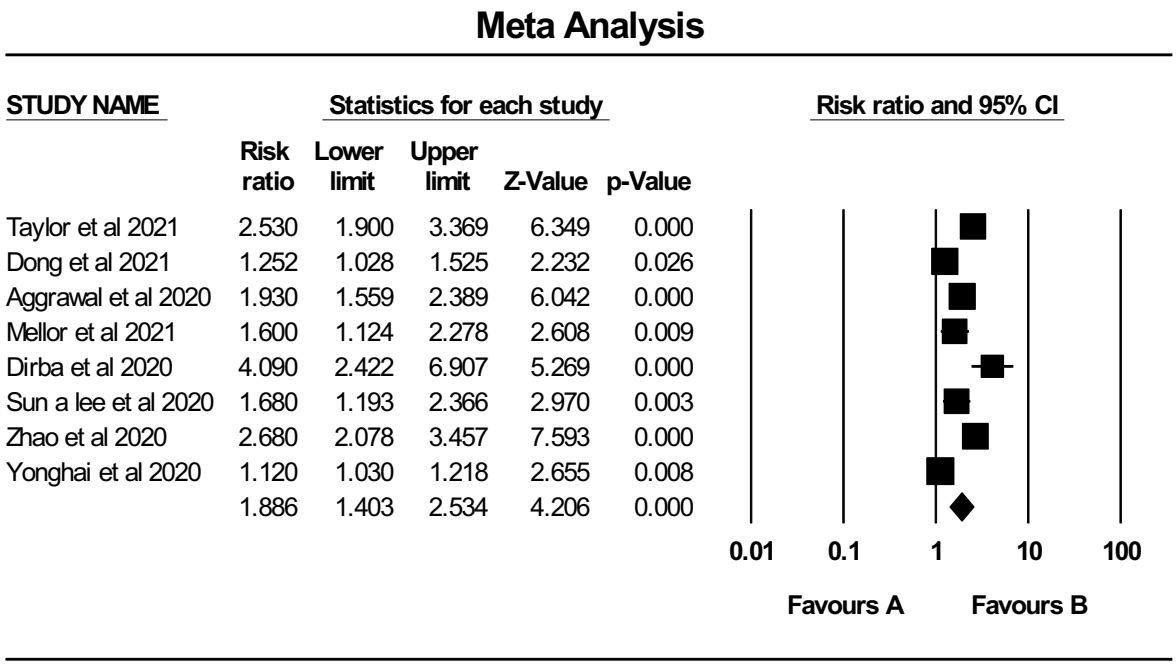
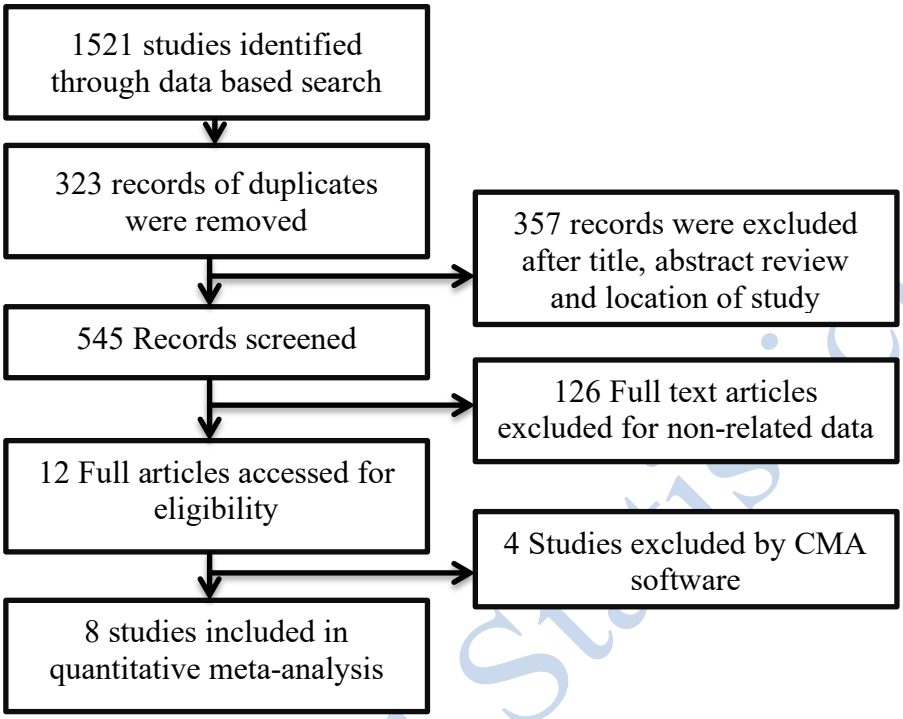


Table 1 shows the result of the analysis carried out for 8 studies to investigate the risk of mortality in patients with comorbidities and Covid-19 in some parts of Africa.
The 8 studies were obtained from (Taylor SA, 2021), (Dong B, 2020), (Aggarwal G, 2020), (Mellor R, 2021), (Sun L, 2020), (Dirba C, 2020), (Zhou F, 2020), (Yonghai D, 2020).

Figure 1: Flow diagram for data on the risk of mortality in patients with Covid-19



III. Conclusion

The resulting summary random effect model is 1.886 while I^2 is 92.7% at 95% CI. The summary effect is greater than 1 and this suggests that patients with comorbidities are at higher risk of mortality. I^2 =92.7% suggest that there is high variation across studies due to heterogeneity, therefore, implementation of adequate protection and intervention for covid-19 patients with comorbidities may significantly reduce the risk of mortality associated with covid-19.

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