Determinants of Death among COVID-19 Patients Admitted in Amhara Region COVID-19 Treatment Centers, Ethiopia, 2021, Unmatched Case Control Study

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Abstract

Background: The rapid emergence of the novel coronavirus disease 2019 (COVID-19) has resulted in millions of infected patients and deaths in worldwide. Studies conducted till today show that the outcome of COVID-19 varies based on individual characteristics. The purpose of this investigation was to identify the determinants of COVID-19 deaths in Amhara Region. The study aimed to identify the determinants of death among COVID-19 patients admitted in Amhara region COVID-19 treatment centers, Ethiopia, 2021.

Method: Unmatched case control study design was conducted among 675 COVID-19 patients (135 case and 540 control by 1:4 ratio) admitted in 8 COVID-19 treatment centers in Amhara region from march 1, 2020 to march 30, 2021. From study participants cases were all death in COVID-19 treatment centers and controls were selected using simple random sampling technique of lottery method. Data were collected by using Epicollect5 software from 8 COVID-19 treatment centers and analyzed via STATA version 14. Mean, median and interquartile range were computed for cases and control groups and Variables that had (P-value < 0.25) in the Bivariable logistic regression analysis were entered in Multivariable logistic regression model. Finally Adjusted Odds ratio (AOR), 95% CI for AOR, and P-values < 0.05 were used to declare statistical significance and interpretation of results.

Result: Analyses were done on 675 COVID-19 patients comprising 135 cases and 540 controls. Factors such as older age (AOR 1.14, 95% CI 1.11-1.17), male sex (AOR 3.63, 95% CI 1.74-7.75), rural residence (AOR 0.21, 95% CI 0.10-0.42), patients who had fever (AOR 3.65, 95% CI 1.72-7.75), Sign of respiratory distress (AOR 4.04, 95% CI 1.94-8.42), hypertension AOR (2.58, 95% CI 1.06-6.25) and diabetes mellitus (AOR 5.3, 95% CI 1.33-8.64) were found to be independent determinants of Death.

Conclusion: Increment in age, male sex, urban residence, having fever and signs of respiratory distress at admission, comorbidity of diabetic Mellitus, and hypertension were found to be significant determinants of death among COVID-19 patients.

Keyword
Amhara region, Case-control, COVID-19, Death, Determinant

Acronyms
ACE: Angiotensin-Converting Enzyme; AHR: Adjusted Hazard Ratio; ARBs: Angiotensin Receptor Blockers; ARDS: Acute Respiratory Distress Syndrome; BOS: Blood Oxygen Saturation; COPD: Chronic Obstructive Pulmonary Disease; ICU: Intensive Care Unit; IMV: Invasive Mechanical Ventilation; NCIP: National Commission on Indigenous Peoples; NHC: National Health Commission; NGO: Non Governmental Organization; MERS: Middle East Respiratory Syndrome; RT-PCR: Reverse Transcriptase-Polymerase Chain Reaction; SARS: Severe Acute Respiratory Syndrome; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; SPSS: Statistical Package for Social Science; SOFA: Sequential Organ Failure Assessment; WHO: World Health Organization

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Background

Coronavirus illness (COVID-19) could be a worldwide catastrophe, with rapid dispersion, that has influenced passing around the world. It may be a breathing disease that can spread from person to person causing virus in extreme cases and death. It was, to begin with, reported in China and the World Health Organization asserted the event of a widespread [1].

COVID-19 debasements are rumored to spread through breathing large droplets, contact with body fluids, and with contaminated surfaces. The COVID-19 scourge is transmitted person to person through tainted discuss precipitation, individuals making contact with fingers or faces that contain the infection and after that touching their eyes, nose, or mouth with unclean hands [2].

All arrive borders have since been closed as an infection control degree with several restrictions and execution of physical distancing and mask-wearing measures. But the pandemic is rising due to a temperature change (summer season) and the public ignoring Ministry of Health’s rules for controlling the COVID-19 pandemic. Even though such measures wear taken in Ethiopia, death the record becomes rise (274,480 cases with 4,257 deaths) since the epidemic began, according to Ethiopia’s Ministry of Health June 16, 2021. In addition, Amhara region there are 11,791 positive cases from 290,889 testes and 293 deaths of covid-19 [3].

Internationally, healthcare services delivery is being compromised due to the surge in the number of infected patients during this COVID-19 pandemic. Overwhelming the health-care the system will lead to an unexpected rise in morbidity and mortality of various treatable conditions.

Therefore, it is critical to risk stratify COVID-19 patients based on their predicted outcomes and guide appropriate management and disposition accordingly. The clinical manifestation of COVID-19 is broad and ranges from asymptomatic and mild upper respiratory tract symptoms to severe illnesses with multi-organ failure and death [4].

Furthermore, it is challenging to predict the clinical course or determine patients at risk of deterioration. Previous reports showed that old age and male gender are risk factors for disease severity and mortality other medical comorbidities are associated with poor prognoses such as cardiovascular disease, diabetes mellitus, chronic respiratory disease, and hypertension [5-7].

Even though Ethiopia is among the top four leading African countries with the COVID-19 case, there is only one study conducted on the determinants of death among COVID-19 patients [8], they recommended conducting further research that investigates the determinants of death among COVID-19 patients in a broader social context and larger sample size. This research will try to fill this gap by broadening the study area, relatively increasing the sample size and adding some variables in socio-demographic characteristics like marital status, residence, occupation, and admission symptoms characteristics.

Methods

The state of Amhara consists of 10 administrative zones, one special zone, 105 wored, and 78 urban centers. In the Amhara region, there are 15 COVID-19 test sites and 8 treatment sites which are Gonder University, Tibebe Ghion hospital, Debre Birhan-Tebasi health center, Borumed a hospital, Debre Marks University, Injibara University, Kobo hospital, and Dessie hospital COVID-19 treatment center. Institution-based unmatched case-control study design was employed from all laboratory-confirmed COVID-19 cases located in COVID-19 treatment centers in Amhara Region from March 1, 2020, to March 30, 2021. The information available in the eligible patients’ medical records was observed and then recorded using the epicollect5 data extraction tool prepared by adapting from different studies which consist of socio-demographic factors, co-morbidity factors, admission signs, and vital signs. Then, from COVID-19 patients, diagnosed between from March 1, 2020, to March 30, 2021, using simple random sampling technique by lottery method select controls from medical records and then reviewed baseline records and death certificate supplemented was identified from medical records by their medical record number. Then, the records of the study participants were selected according to the eligibility criteria.

Data processing and analysis

After the data collection, Data were first checked for completeness then the data were downloaded from epicollect5 and exported to STATA™ 14.1 for analysis. The data were checked Based on the nature of variables frequency distribution, summary statistics such as mean, median, and IQR were computed for cases and control groups.

Extent of multicollinearity between independent variables was measured using variance inflation factor (VIF) for contentious data and for a categorical variable using correlation coefficient. Regression model assumptions were checked using a test like the Hosmer & Leme show goodness of fit test to identify and exclude variables that cause poor fit in the model. The bivariable logistic regression model was fitted for each explanatory variable. Accordingly, those variables having a p-value less than 0.25 [9] in the bivariable analysis were taken as candidates for the multivariable logistic regression model. In a multivariable logistic regression AOR with
dead patents since the Center started admission on March 1, 2020, up to March 30, 2021, and then with a 1:4 ratio of a case to control (135 cases (deaths) and 540 controls (recovered)) a total of 675 patients were included in the study. To select controls, a simple random sampling method was employed to recruit these study participants from all medical records of a confirmed diagnosis of COVID-19 patients registered from March 1, 2020, to March 30, 2021, were assessed.

**Ethical approval**

Ethical clearance was obtained from the Institutional Review Boards (IRB) of Bahir Dar University, College of Medicine and Health Sciences with protocol number 087/2021. The chief executive officer at Hospitals offered permission to conduct the study. Confidentiality was maintained by omitting the personal identifier of the participant during the data collection procedure and information was used only for research purposes.

**Result**

**Socio-demographic characteristics**

Median age of the patients is 42-years-old with an IQR of 56 – 33 = 23. Almost two-thirds (57.6 %) of the patients were male. More than one-third (34.9%) of patients were unemployed. Regarding marital status and residence 450 (66.7%) patients were married and 411 (60.9%) were urban residents (Table 1).

**Clinical sign and symptoms characteristics**

Almost all 634 (93.9%) of the patients had a history of admission signs and symptoms. The majority had a headache (77%) and followed by cough (68.7%), (Table 2).

**Pre-existing comorbidity characteristics**

Regarding comorbidity characteristics, 201 (29.8%) of the patients had a history of one or more pre-existing co-morbid illness. When we compare case and control

| Variable     | Control Number (%) | Case Number (%) | Total Number (%) |
|--------------|--------------------|----------------|-----------------|
| **Sex**      |                    |                |                 |
| Male         | 290 (53.7)         | 99 (73.6)      | 389 (57.6)      |
| Female       | 250 (46.3)         | 36 (26.7)      | 286 (42.4)      |
| **Occupation**|                   |                |                 |
| Employed     | 346 (64.1)         | 93 (68.9)      | 439 (65.1)      |
| Un Employed  | 194 (35.9)         | 42 (37.1)      | 236 (34.9)      |
| **Marital status**|               |                |                 |
| Married      | 361 (66.9)         | 89 (65.9)      | 450 (66.7)      |
| Not married  | 179 (32.6)         | 46 (34.1)      | 225 (33.3)      |
| **Residence**|                   |                |                 |
| Urban        | 307 (56.9)         | 104 (77.0)     | 411 (60.9)      |
| Rural        | 233 (43.1)         | 31 (22.9)      | 264 (39.1)      |
Table 2: Symptom of COVID-19 patients at admission time in Amhara region COVID-19 treatment centers (n = 675) in Ethiopia, 2021.

| Variables      | Control Number (%) | Case Number (%) | Total Number (%) |
|----------------|--------------------|-----------------|------------------|
| Headache       |                    |                 |                  |
| No             | 120 (22.2)         | 35 (25.9)       | 155 (22.9)       |
| Yes            | 420 (77.8)         | 100 (74.1)      | 520 (77.1)       |
| Vomiting       |                    |                 |                  |
| No             | 479 (88.1)         | 117 (86.7)      | 593 (87.8)       |
| Yes            | 64 (21.9)          | 18 (13.3)       | 82 (12.2)        |
| Coma           |                    |                 |                  |
| No             | 523 (96.8)         | 128 (94.8)      | 651 (96.4)       |
| Yes            | 17 (3.2)           | 7 (5.2)         | 24 (3.6)         |
| Diarrhea       |                    |                 |                  |
| No             | 468 (86.7)         | 112 (82.9)      | 580 (85.9)       |
| Yes            | 72 (23.3)          | 23 (17.1)       | 95 (14.1)        |
| Fever          |                    |                 |                  |
| No             | 255 (43.2)         | 31 (22.9)       | 286 (42.4)       |
| Yes            | 285 (52.8)         | 104 (77.0)      | 389 (57.6)       |
| Chest pain     |                    |                 |                  |
| No             | 236 (43.7)         | 57 (42.2)       | 293 (31.2)       |
| Yes            | 304 (56.3)         | 78 (57.8)       | 382 (68.8)       |
| Cough          |                    |                 |                  |
| No             | 184 (34.1)         | 27 (20.0)       | 211 (31.3)       |
| Yes            | 356 (65.9)         | 108 (80.0)      | 464 (68.7)       |
| Throat pain    |                    |                 |                  |
| No             | 425 (78.7)         | 97 (71.9)       | 522 (77.3)       |
| Yes            | 115 (21.3)         | 38 (28.1)       | 153 (22.7)       |
| Runny nose     |                    |                 |                  |
| No             | 480 (88.9)         | 116 (85.9)      | 596 (88.3)       |
| Yes            | 60 (21.1)          | 19 (14.1)       | 79 (11.7)        |
| Sign of respiratory distress | | | |
| No             | 461 (85.4)         | 59 (43.7)       | 520 (77.1)       |
| Yes            | 79 (24.6)          | 76 (56.3)       | 155 (22.9)       |

Table 3: Pre-existing co-morbid illness of COVID-19 patients in Amhara region COVID-19 treatment centers (n = 675) in Ethiopia, 2021.

| Pre-existing Co-morbidity | Control Number (%) | Case Number (%) | Total Number (%) |
|---------------------------|--------------------|-----------------|------------------|
| Hypertension              |                    |                 |                  |
| No                        | 507 (93.9)         | 101 (74.8)      | 608 (90.1)       |
| Yes                       | 33 (6.1)           | 34 (25.2)       | 67 (9.9)         |
| Diabetes mellitus         |                    |                 |                  |
| No                        | 508 (94.1)         | 97 (71.8)       | 605 (89.6)       |
| Yes                       | 32 (5.9)           | 38 (28.2)       | 70 (10.4)        |
| Asthma                    |                    |                 |                  |
| No                        | 520 (96.3)         | 120 (88.9)      | 640 (94.8)       |
| Yes                       | 20 (3.7)           | 15 (11.1)       | 35 (5.2)         |
| HIV                       |                    |                 |                  |
| No                        | 507 (93.9)         | 118 (87.4)      | 625 (92.6)       |
| Yes                       | 33 (6.1)           | 17 (12.6)       | 50 (7.4)         |
of fever at baseline/diagnosis compared to those with no symptom of fever at baseline/diagnosis (AOR = 3.65, 95% CI = 1.72-7.75) and the odds of death because of COVID-19 is 4.04 times higher among those with a sign of respiratory distress at baseline/diagnosis compared to those without sign of respiratory distress at baseline/diagnosis (AOR = 4.04, 95% CI = 1.94-8.42). Similarly, on the comorbidity characteristics, the odds of death due to COVID-19 is 3.39 times higher among those with a history of diabetes compared to those with no diabetes (AOR = 3.39, 95% CI = 1.33-8.64) and the odds of dying among those with a history of hypertension were 2.58 times higher compared to those with non-hypertensive (AOR = 2.58, 95% CI = 1.06-6.25) (Table 5).

Discussion

The overall aim of this study was to identify the determinants of death among COVID-19 patients admitted in Amhara region COVID-19 treatment centers. Accordingly, seven factors were found to be significant determinants of death in patients with COVID-19 disease. This study indicated that an increment in age has a significant effect on death due to COVID-19. This finding is supported by studies done in Millennium COVID-19 Care Center [8], Wuhan China [7], Brazil [10], the Democratic Republic of the Congo study [11], Lombardy Italy [12], and on sub-Saharan research [13]. The possible reasons for this could be as Age increases it causes numerous biological changes in the immune system, which are linked to age-related illnesses and susceptibility to infectious diseases, these changes determine not only the susceptibility to infections but also disease progression and clinical outcomes thereafter [14]. On the other hand, the

| S.No | Vital sign at presentation | Control (Mean) | Case (Mean) | Total (Mean) | P value |
|------|---------------------------|----------------|-------------|--------------|---------|
| 1.   | Temperature (°C)          | 36.20          | 37.14       | 36.39        | 0.0002* |
| 2.   | Heart rate (Beats/min)    | 91.46          | 99.20       | 93.02        | 0.0003* |
| 3.   | Respiratory rate (RR/min) | 22.46          | 33.48       | 24.67        | 0.0001* |
| 4.   | SBP (mmHg)                | 117.83         | 114.44      | 117.15       | 0.1261  |
| 5.   | DBP (mmHg)                | 79.52          | 81.78       | 79.98        | 0.0651  |
| 6.   | Spo2 (%)                  | 91.63          | 82.53       | 89.81        | 0.0001* |

Table 4: The independent t-test of Baseline vital sign between control (alive) Vs. case (dead) group among COVID-19 patients in Amhara region COVID-19 treatment centers (n = 675) in Ethiopia, 2021.

28% of Diabetic patients are died followed by 25% hypertension patients are died (Table 3). Baseline vital signs of COVID-19 patients

The independent t-test result shows that comparing those who have discharged alive Vs. died patients who died had a significantly higher mean admission temperature (36.20 °C Vs. 37.14 °C, p-value = 0.0002), heart rate (91.46 Beats/min vs. 99.20 Beats/min, p-value = 0.0003), respiratory rate (22.46 RR min vs. 33.4 RR/min, p-value = 0.0001) and lower mean admission SpO₂ (91.63% vs. 82.52%, p-value = 0.0001) (Table 4). Determinants of death among COVID-19 patients

Based on the result of the binary logistic regression analysis at a 25% level of significance; Age, sex, residence, fever, cough, a sign of respiratory distress, hypertension, diabetes mellitus, asthma and HIV were found to be a candidate for multiple Logistic Regression models. However; only age, sex, residence, fever, the sign of respiratory distress, hypertension, and diabetes mellitus were found to be significantly associated with mortality of COVID-19 patient’s multiple Logistic Regression model at 5% level of significance. Accordingly, after adjusting other covariates, as the patient’s age increased by one year the odds of death due to COVID-19 increased 1.14 times (AOR = 1.14, 95% CI = 1.11-1.17), the odds of death because of COVID-19 is 3.63 times higher among those male patients compared to female patients (AOR = 3.63, 95% CI = 1.74-7.55). Rural residents are 21% less likely to die as compared to urban residents (AOR = 0.21, 95% CI: 0.10-0.42). From the Admission sign and symptoms, the odds of death due to COVID-19 is 3.67 times higher among those with having symptoms of fever at baseline/diagnosis compared to those with no symptom of fever at baseline/diagnosis (AOR = 3.65, 95% CI = 1.72-7.75) and the odds of death because of COVID-19 is 4.04 times higher among those with a sign of respiratory distress at baseline/diagnosis compared to those without sign of respiratory distress at baseline/diagnosis (AOR = 4.04, 95% CI = 1.94-8.42). Similarly, on the comorbidity characteristics, the odds of death due to COVID-19 is 3.39 times higher among those with a history of diabetes compared to those with no diabetes (AOR = 3.39, 95% CI = 1.33-8.64) and the odds of dying among those with a history of hypertension were 2.58 times higher compared to those with non-hypertensive (AOR = 2.58, 95% CI = 1.06-6.25) (Table 5).
This finding contradicts studies conducted in the United States [17] and South Carolina [18]. The possible reason for this could be rural residents are not seeking health centers due to multiple barriers such as lack of health care resources (e.g., transportation, health insurance, 26 providers, and facilities), geographic distance, and lower socioeconomic status and also they are not able to test COVID-19 virus and also Compared with urban residents, urban residents have higher rates of morbidity and mortality from various diseases with their sedentary way of life [19]. The present study also revealed that clinical signs and symptoms, such as fever and signs of respiratory distress were significantly associated with the death. This finding is in line with studies done in Democratic Republic of the Congo study [11], Lombardy Italy [12], and sub-Saharan research [13]. Therefore, Patients with fever and sign of respiratory distress tended to have increased rates of pulmonary embolism and coagulopathy. This is in keeping with the observation of increased prevalence of pulmonary embolism amongst COVID-19 patients seen in Europe [20]. In other way, a compromised immunity due to different causes the immune system unable

### Table 5: Results for the final multi-variable binary logistic regression model among COVID-19 patients in Amhara region COVID-19 treatment centers (n = 675) in Ethiopia, 2021.

| Variable                  | Category        | Outcome | Bi variable | Multi variable analysis |
|---------------------------|-----------------|---------|-------------|-------------------------|
|                           | Control No (%)  | Case No (%) | COR (95% CI) | AOR (95% CI) |
| Socio demographic variables |                 |          |             |             |
| Age                       | Male            | 290 (53.7) | 99 (73.6)   | 1.13 (1.11-1.15) | 1.14 (1.11-1.17) |
|                           | Female          | 250 (46.3) | 36 (26.7)   | 2.37 (1.56-3.59) | 3.63 (1.74-7.55) |
| Residence                 | Urban           | 307 (56.9) | 104 (77.0)  | 1                       | 1 |
|                           | Rural           | 233 (43.1) | 31 (22.9)   | 0.39 (0.25-0.60) | 0.21 (0.10-0.42) |
| Admission sign and symptoms|                 |          |             |             |
| Fever                     | Yes             | 285 (52.8) | 104 (77.1)  | 3.00 (1.94-4.63) | 3.65 (1.72-7.75) |
|                           | No              | 255 (47.2) | 31 (22.9)   | 1                       | 1 |
| Cough                     | Yes             | 356 (65.9) | 108 (80.0)  | 2.02 (1.30-3.26) | 1.05 (0.47-2.33) |
|                           | No              | 184 (34.1) | 27 (20.0)   | 1                       | 1 |
| Throat pain               | Yes             | 115 (21.7) | 38 (28.2)   | 1.44 (0.94-2.22) | 2.07 (0.90-4.73) |
|                           | No              | 425 (78.3) | 97 (71.8)   | 1                       | 1 |
| Sign of Respiratory distress| Yes            | 79 (24.6) | 76 (56.3)   | 7.51 (4.96-11.38) | 4.04 (1.94-8.42) |
|                           | No              | 461 (85.4) | 99 (43.7)   | 1                       | 1 |
| Pre-existing comorbidity   |                 |          |             |             |
| Hypertension              | Yes             | 33 (6.1)  | 34 (25.2)   | 5.17 (3.06-8.73) | 2.58 (1.06-6.25) |
|                           | No              | 507 (93.9) | 101 (74.8)  | 1                       | 1 |
| Diabetes mellitus         | Yes             | 32 (5.9)  | 38 (28.2)   | 6.21 (3.70-10.43) | 3.39 (1.33-8.64) |
|                           | No              | 508 (94.1) | 97 (71.8)   | 1                       | 1 |
| Asthma                    | Yes             | 20 (3.7)  | 15 (21.1)   | 3.24 (1.61-6.53) | 2.60 (0.88-7.65) |
|                           | No              | 520 (96.3) | 120 (88.9)  | 1                       | 1 |
| HIV                       | Yes             | 33 (6.1)  | 17 (12.6)   | 2.21 (1.19-4.10) | 1.06 (0.35-3.20) |
|                           | No              | 507 (93.9) | 118 (87.4)  | 1                       | 1 |
to mount the ordinary reactions to threats like fever which leads the person to have a higher risk of serious infection and Shortness of breathing is a manifestation of decreased lung function and is considered as a sign of a life-threatening condition. Patients with persistent shortness of breath complaint are those with such lower lung reserve, functional or anatomical cause, that makes them vulnerable to a virus like COVID-19 and are unable to cope with the stress leading to a bad prognosis [21].

Being diabetic was found to be an important predictor of disease outcome. The odds of death due to COVID-19 are 3.39 times higher among those with a history of diabetes compared to those with no diabetes. The result also seems to be the case in others’ setup as it is reported that having diabetes mellitus is associated with studies conducted in Millennium COVID-19 Care Center [8], Wuhan China [7], Brazil [10], the Democratic Republic of the Congo study [11] and Lombardy Italy [12]. Although the pathophysiology involved in this comorbidity remains unexplained, several hypotheses have been suggested. Blood glucose level is suggested to play an essential role in the pathogenesis of infectious diseases. The immune system of diabetes patients might be altered by the abnormal blood glucose level, resulting in dysregulation and reduced responses of immune components. Consequently, these patients are susceptible to SARS-CoV-2 and various other types of bacteria [21]. Especially if poorly controlled, is known to lead to compromised immunity that decreases the body’s ability to fight off any infection including viral infections like COVID-19. Also, the chances of having and/or developing another chronic illness are higher than non-diabetic individuals. This results in any diabetic patient being 27 vulnerable to develop symptomatic infection and complications from any infectious disease that could result in worse disease prognosis [22].

The findings of this study showed that hypertension had a statistically significant association with death due to COVID-19. The result was in line with studies conducted in Wuhan China [7], the Democratic Republic of the Congo study [11], and Lombardy Italy [12]. This might be linked to, hypertension being treated with ACE inhibitors and ARBs, which results in up-regulation of ACE2 and SARS-CoV-2 binds to their target cells through ACE2. Consequently, the increased expression of ACE2 in hypertension patients, receiving ACE inhibitors would facilitate infection with COVID-19 and decrease blood flow to the brain, which results in oxygen deficiency and also, the chances of having and/or developing other chronic illnesses [23]. Thus, chronically hypertensive patients often have target organ damage that increases susceptibility for SARS-CoV-2 and elevates the risk of unfavorable outcomes in COVID-19 patients [20].

Conclusion

Finally, the study revealed that the death of COVID-19 patients was determined by the following socio-demographic factors such as age increments, male sex, having a fever, and a sign of respiratory distress at admission was also significantly affected the outcome of COVID-19 patients. Rural residents are a preventative factor for determinants of death in COVID-19 patients. Furthermore having comorbidity of diabetic Mellitus and hypertension were found to be significant determinants of death in COVID-19 patients. Based on the findings what the study revealed the following recommendations were given to concerned stakeholders. A special care plan for a patient having comorbidity of hypertension and diabetic Mellitus might be formulated and implemented by the Federal ministry of health. In addition, it is advised for health professionals to give more careful follow-up for aged, male, diabetic, and hypertensive COVID-19 patients. Finally, I recommend to researchers to do strong study designs like prospective study designs.

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Author Contributions

ZA conceived of the study and oversaw the study. ZA, MB, AB, TN, SF, and AM designed the study. AM, SF, and ZA prepared the data and performed the statistical analysis. ZA conducted a background literature review and drafted the manuscript. ZA, MB, AB, TN, SF, and AM interpreted the results, critically reviewed and edited the manuscript, approved the final version, and agreed to be accountable for all aspects of the work.

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Competing Interest’s Statement

The author reports no conflicts of interest in this work.

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