Outbreak Investigation: First Ten COVID – 19 Infection Related Deaths in Hodeidah, Yemen

ABSTRACT

Background: A many of acute respiratory syndrome coronavirus 2 (SARS-CoV-2). related deaths were reported in Yemen . The question about what risk factors contributing to this excess death? Hodeidah governorate at Western part of Yemen exposed to COVID-19 pandemic like other governorates in Yemen, adding to the current chronic problems. No study till now documented the SARS-CoV-2 pandemic process in Hodeidah, Yemen especially deaths.

Objective: The aim of this short report is to explore more data about the first ten SARS-CoV-2 related deaths in Hodeidah . Yemen.

Methods: A descriptive study (series case) of patients records who died after were received in triage area of Center of Tropical Medicine and Infectious Diseases (CTMID), AL-Thawrah Public Hospital Authority, Hodeidah, Yemen from 24th to 31st May 2020.

Results: The first ten death patients in the same time was investigated, the age ranging was from 25-65 years with the median age of 57.5 years, seven deaths (70%) were at age over 50 years while males are more exposed to deaths (eight cases ; 80%) . The deaths are more in residents of urban (eight cases ; 80%) than rural areas (20%). Co-infections with other communicable diseases were reported in 3 died patients (30 %); tuberculosis, dengue and hepatitis B (HVB). While six died patients (60%) had non-communicable diseases namely diabetes mellitus, heart disease, hypertension, chronic asthma, and chronic renal failure uncontrolled. One death (10 %) of medication error in private sector (non – isolation center facilities ; sub-standard management)

Conclusion: Old age and co-morbidity with non-communicable diseases may be contributing factors to excess deaths among SARS-CoV-2 patients. Co-infections with other infections like dengue is of high concern in Hodeidah, Yemen. Post-epidemiological investigation, the control and prevention measures were implemented by local authorities in collaboration with private sector and non-governmental organizations namely re-habitation of SARS-CoV-2 isolation center to reduce the mortality rate, also different practices and knowledge to reduce the morbidity rate.

Keywords: COVID-19, Mortality , Hodeidah, Yemen

1. INTRODUCTION

Acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a respiratory disease that is caused by novel single-stranded positive sense RNA virus (nCoV-19) that was firstly isolated in 31 December 2019 when emerged in Wuhan, Hubei Province, China [1,2]. The resulting diseases so called SARS-CoV-2 which then emerged worldwide and caused mortality globally at the rate of 3.7% till the 12th of March 2020 when declared by World Health Organization (WHO) as a pandemic [3]. The emergence of SARS-CoV-2 expanded

to 216 country causing 356,254 deaths and 5,657,529 confirmed cases all over the world till May 29, 2020 [4]. However, chronic pulmonary diseases and lower respiratory infections are two of the top ten global causes of death [5]. Disease severity is ranging from mild non-fatal respiratory illness to more serious complications that may lead to death while associated with chronic diseases or other communicable diseases [6,7]. Mainly the more susceptible patients for mortality were those who experienced SARS-CoV-2 and a co-morbidity, with diabetes and hypertension being the most common co-morbid followed by coronary heart disease and older aged patients [8-12]. Clinical features of SARS-CoV-2 include Lower respiratory tract infection related symptoms mainly fever, dry cough and dyspnea as reported in the initial case series from Wuhan, China. In addition, headache, dizziness, weakness, vomiting and diarrhea were also observed. [13-15]. In Yemen the first case was registered in April 10,2020 in Hadhramout then emerged to other parts of the country [16-17]. A many of deaths were reported in Yemen raising the question about what risk factors contributing to this excess death ? No study till now documented the SARS-CoV-2 pandemic process in Hodeidah, Yemen especially deaths. Therefore , the aim of this short communication is to explore more data about the first ten SARS-CoV-2 related deaths of Hodeidah , Yemen in May 2020.

2. MATERIALS AND METHODS

2.1. Study area

Hodeidah governorate at Western part of Yemen exposed to sever acute respiratory infection (SARI) like other governorates in Yemen, adding to the current chronic problems. Hodeidah is facing complex spectrum of determinants of health; including poverty, illiteracy, food insecurity, malnutrition and multiple epidemics as well as humanitarian crises resulting from the ongoing armed conflicts since 2015 [18].

2.2. Outbreak investigation

The steps listed were presented in conceptual order; in practice, however, ten steps may be done at the same time: **I) Prepare for field work**: The team included professors and consultants in epidemiology, pharmacology of infectious diseases, radiology, internal medicines . Also specialists in public health and microbiologist (virologist). The appropriate supplies and equipment were prepared to carry out the investigation before departing for the field. **II) Establish the existence of an outbreak**: From 24th May to 31st May 2021. Patients with SARI in Hodeidah, Yemen were investigated. **III) Verify the diagnosis**: Reference hospital supported the clinical, radiological, hematological and biochemical finding . Also two laboratories namely CTMID laboratory in Hodeidah and National Center of Public Health Laboratories (NCPHL) in Sana'a confirmed the cases. On the other mean, the nasopharyngeal swabs were collected from cases and confirmed by Real Time - Polymerase Chain Reaction (RT-PCR). **IV) Construct a working case definition**: National case definition that was extracted from WHO guideline and used to screen and triage the cases epidemiologically (suspected, probable and confirmed) and clinically (mild, moderate, severe and critical cases). **V) Find cases systematically and record information**: The general information (name, address, and telephone number. Also, the demographic information (age, sex, residence). The clinical information (symptoms, signs, date of onset, duration of illness and whether hospitalization or death occurred). Risk factors information (specific disease and other infection). In addition, other information (source of the report, usually a physician, clinic, hospital, or laboratory) were reported. **VI) Perform descriptive epidemiology**: The data were summarized to provide a comprehensive characterization of the outbreak - trends over time, geographic distribution (place), and the populations (persons) affected by the disease and at risk for the disease. The etiological, source, and modes of transmission were hypotheses. Data after being collected from were checked for completeness, entered into excel format then analyzed using tables, graphs , average , median, range, frequency and percentages were the main

descriptive tools. **VII) Evaluate hypotheses epidemiologically**: The descriptive study (case series) was chosen in this analysis. **VIII) Implement control and prevention measures**: The control and prevention measures were implemented. CTMID continued to monitor. COVID -19 isolation department was built. **IX) Communicate findings:** Oral and written report were presented for local authorities namely AL Thawrah Public Hospital of Hodeidah, Epidemiological Surveillance and Control Diseases Administration - Office of Public Health and Population. Also for Governorate of Hodeidah, Yemen and non-governmental organizations. **X) Initiate or maintain surveillance**: The surveillance was implemented namely active and passive [19-21].

3. RESULTS

3.1. Socio-demographic factors

During the study period, the analysis of first 10 death patients in the same time were reported at triage area of CTMID , AL-Thawrah Public Hospital Authority, Hodeidah, Yemen. All cases had Acute Respiratory Distress Syndrome (ARDS) for a period of two weeks before hospitalization. All the ten deaths were confirmed having SARS-CoV-2 infection by using RT-PCR technique. The general characteristics of patients were shown in Table 1, their age ranging was from 25-65 years with the median age of 57 years, seven deaths (70 %) were at age over 50 years while males were more exposed to eight cases (80%) and deaths were more in residents of urban (eight cases ; 80%) than rural areas (two cases ; 20%) (Table 1).

Table 1: General socio-demographic data of COVID-19 death patients in Hodeidah , Yemen (N =10)

Variables	Number(n)	Ratio (%)
Gender		
Male	8	80
Female	2	20
Age		
<15	0	0
15-29	2	20
30 -49	1	10
50-59	3	30
60+	4	40
Residency		
Urban	8	80
Rural	2	20

Note: 50 patients were received in triage area of CTMID from 24th to 31st May, 2020. and 29 cases were died namely case fatality rate (CFR) was 29/50 cases (58 %). The first ten death in the same time (the same day) were confirmed based on RT-PCR and the causes of death were investigated (Table 1). Other cases were confirmed epidemiologically (epidemiologically linked case: a case in which the patient has/has had contact with one or more persons who have/had the disease, and transmission of the agent by the usual modes of transmission is plausible. A case may be considered epidemiologically linked to a laboratory-confirmed case if at least one case in the chain of transmission is laboratory confirmed). On the other hand, the males (40 cases; 80 %) were significantly (X^2 = 18; p = 0.0002) overrepresented in this group compared with females (10 cases; 20 %) and the age range of patients was from 19-90 years old and the median age of subjects was 60 years. Also, we observed a statistically higher frequency of SARS-CoV-2 infection was 37 cases (82 %) in older patients from 50 – 90 years old , and the lowest frequency was 13 cases (26 %) in adult from 15 – 49 years old (X^2 = 11.52 ; p = 0.00069). In addition, regarding the area of residence, only 40 cases (80 %) of COVID -19 infection were from the urban area; whereas 10 cases (20 %) were from rural area. However, this difference statistically significant (X^2 = 18; p = 0.0002). Finally, as for seasonal distribution, the first cases of SARS-CoV-2 infection were detected in the spring season , May 2020.

3.2. Clinical , radiological , hematological and biochemical finding

The most clinical, radiological, hematological, and biochemical findings were summarized in Table 2. Clinically; the ideal clinical findings were present such as fever, dry cough, chest pain, difficulty in breathing (oxygen saturation < 75 %), acute respiratory distress syndrome (ARDS) , lymphopenia , and lung involvement.

Table 2: Clinical , radiological , hematological and biochemical finding of COVID-19 death patients in Hodeidah , Yemen (N = 10)

Criteria	Finding
Clinical	The most common clinical symptom observed in the patients with SARS-CoV-2 was difficulty breathing and hypoxia less than 75 %, followed by fever, arthritis, cough, pharyngitis and chest pain. All cases had ARDS for a period of a two weeks to three weeks before hospitalization.
Radiological	4 cases (40 %) of CO-RAD 4 and 6 cases (60 %) of CO-RAD 5. The most patterns were 80 % of ground glass opacifications (GGO), bilateral involvement, multi-lobar involvement, 70 % of peripheral distribution, 60 % of consolidation pattern and 10 % of crazy paving pattern.
Hematological	White blood cells (WBCs) were 20 ± 5 ($\times 10^9$/L) (leukocytosis), lymphocytes decreased (lymphopenia) with SARS-CoV-2 infection to 2% with average 5±3%. In addition, neutrophils increased (neutrophilia) to 98 % with average 95±3%. On the other hand, the results showed increased in Neutrophils to Lymphocytes Ratio (NLR) that was 98/2 (49 %).
Biochemical	The major changing in biochemical parameters was hyperglycemia (6 cases ; 60%) with HbA1C more than 7 % and blood glucose more than 350 mg/dl , hypoalbuminemia (80 %) with albumin less than 2.5 mg /dl ; high level in creatinine (1 case ; 10 %); C-Reactive Protein (CRP) more than 6 mg/L .

3.3. Co-morbidity and Co-infection in SARS-CoV-2 Mortality

Mortality rate was high in patients that experienced SARS-CoV-2 in comorbidity with other infections as three cases (30%), mainly one case (10%) with tuberculosis, one case (10%) with dengue and one case (10%) with HBV; moreover, six cases (60%) of comorbidity with non-communicable diseases namely one case (10%) with chronic asthma, one case (10%) with chronic asthma and diabetes, two cases (20%) with heart disorders , hyperlipidemia, hypertension, and diabetes, one case (10%) with chronic renal failure uncontrolled . Finally, one case (10%) of medication error in private sector (sub-standard management).

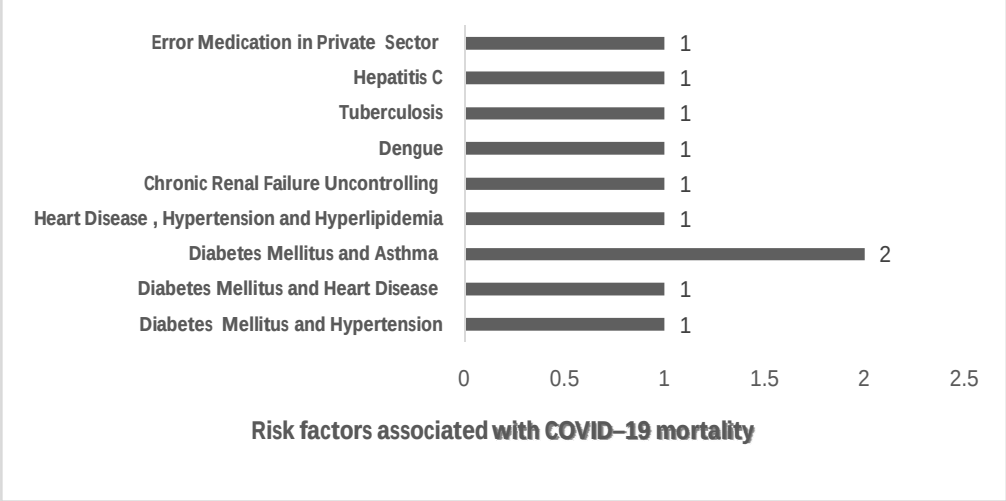

Figure 1: Risk factors associated with SARS-CoV-2 mortality (N: 10)

4. DISCUSSION

Since SARS-CoV-2 pandemic accelerates, governments are warning people at high risk to be particularly stringent in observing social distancing measures because if they become ill they are more likely to need critical care including ventilation, and to die [22]. However, in this study, patients access late to hospital with a serious critical condition. Males were more susceptible to develop death severity [23] and it may due to sex-based immunological or gendered differences, such as patterns and prevalence of smoking [24]. Elderly patients are at greater risk developing SARS-CoV-2 certainly upper that 60 years old, this was according to their underlying health condition with immune response. Krishnan et al reported the mortality from SARS-CoV-2 showed a strong relationship with age and pre-existing medical conditions, as does mortality from other causes. Older age was more strongly associated with COVID-19 death than non- SARS-CoV-2 death, as was male sex, deprivation, obesity, and some comorbidities [25]. Infection co-morbidities with SARS-CoV-2 increase the risk of mortality five times in older subjects [26]. Most commonly reported co-morbidities with SARS-CoV-2 and poses a life threat are diabetes, hypertension, cardiovascular disease and chronic obstructive pulmonary disease, this was similar to what was found in this study due to underlying immunodeficiency, which may made those patients more susceptible to SARS-CoV-2 complications and fatality [27]. Damien et al reported the causes of death that were categorized in four subgroups: (i) refractory respiratory failure, (ii) shock with multiorgan failure, (iii) cardiac death including proven pulmonary embolism (proximal thrombus on CT-pulmonary angiography with acute cor pulmonale on echocardiography and vasopressor requirement) and unexpected cardiac arrest (neither prior oxygen desaturation nor circulatory failure) and (iv) neurological death (ischemic/hemorrhagic stroke with brain herniation) [28].

AL Kamarany et al reported 505 cases in first wave (June – December 2020) of SARS-CoV-2 in Hodeidah that were 9.7 % needed admission in an intensive care unit (ICU) with ARDS and males were more exposed to COVID-19 namely 81.63%, 67.3% of old age . Their study reported 65.3 % of ICU had chronic diseases where the most prevalent were diabetes mellitus and diabetes mellitus associated with other chronic diseases. AL Kamarany et al concluded that, old age, chronic diseases and co-infection were factors that contributed to excess morbidity and mortality among COVID-19 patients and the mortality rate was high overall, with 46.93% with severe and critical COVID19 dying [29,30]. Furthermore, this study able to identify of co-infection between SARS-CoV-2 and dengue , the importance of this result is of high concern especially the study setting (Hodeidah) is a known place for dengue endemicity in Yemen [31-34].

In most epidemiological investigation, the primary goal is control of the outbreak and prevention of additional cases. Indeed, although implementing control and prevention measures was listed after epidemiological analysis of first 10 death related SARS-CoV-2, the local authorities CTMID in Al-Thawra Public Hospital Authority of Hodeidah,, Ministry of Public Health and Population (MOPH) first responsibility is to protect the public's health in collaboration with private sector (Hayel Saeed Anem Companies – Hodeidah Sector) , and non - governmental organizations (Save the Children International– Hodeidah Office , Yemen Country intervened in humanities emergency response project : re-habitation of SARS-CoV-2 isolation center with medical equipment for cases management and to reduce the mortality rate in Hodeidah, Yemen. On the other hand , the major recommendations of control and prevention measures in SARS-CoV-2 infection to reduce the morbidity rate that were listed in different media : i) wash your hands frequently ; ii) avoid touching your eyes , mouth and nose ; iii) cover your cough with the bend of your elbow or tissue ; iv) avoid crowded places; v) stay at home if you feel

unwell even with a slight fever and cough. vi) if you have a fever , cough , and difficulty breathing , seek medical care early – but call by phone first ; vii) stay away of the latest information from Ministry of Public Health and Population (MOPH) [35].

The practices control and prevention activities should be implemented as early as possible [21] but the problems with Yemen's emergency medical services are weak: the healthcare system is under-funded and under-resourced overall. In a country with scarce budget available, few resources, and poorly compensated emergency medicine staff and physicians, a depleted workforce due to mass outward migration of qualified professionals is somewhat inevitable. Systematic revisions to the health care system, rebuilding primary health care facilities, guaranteed universal insurance plans, a greater emphasis toward preventive medicine and continued training in emergency medicine, are needed to help overcome these challenges [36]. AL Thawrah Public Hospital Authority, the reference public health facility in Hodeidah city, Yemen that is still operational but threatened by fighting and rapidly moving frontlines. Airstrikes, ground attacks, military occupation and assaults on health workers are all common occurrences in Yemen. The staff who work in them are poorly equipped and underpaid: it is hardly surprising many migrate to escape such a challenging working environment. As efforts are made to improve Yemen's healthcare system, emergency care must be part of such discussions [37,36].

Limitations of the study: There are some limitations in this study that need to be considered. The small samples size in death cases . Therefore , the study will include large sample size

4. CONCLUSION

Old age and co-morbidity with non-communicable diseases may be contributing factors to excess deaths among SARS-CoV-2 patients. Co-infections with other viral infections like dengue is of high concern in Hodeidah, Yemen. Post-epidemiological investigation, the control and prevention measures were implemented by local authorities in collaboration with private sector and non-governmental organizations namely re-habitation of SARS-CoV-2 isolation center to reduce the mortality rate and different practices and knowledge to reduce the morbidity rate. The study recommended that there must be a more focused approach to preventive medicine and a better understanding of chronic disease within the Yemeni peoples to help to ensure scarce resources are allocated most effectively.

ACKNOWLEDGEMENTS

The authors would like to thank the supervisor and medical staff of the Center of Tropical Medicine and Infectious Diseases (CTMID), Al-Thawara Public Hospital Authority, Hodeidah , Yemen for their fruitful assistance.

COMPETING INTERESTS

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. M. Amood AL Kamarany is Associated Professor in Pharmacology of Infectious , Epidemic Diseases and Tropical Medicine) and scientific consultant on COVID-19 humanitarian project in Hodeidah ,Yemen and wrote, revised and edited the final manuscript and responsible for summarizing all epidemiological and clinical data; K.A. Suhail is supervisor of COVID-

19 humanitarian response project ; A.S. Majam collected the epidemiological and clinical data ; E. A. Alabsi is technical supervisor of project and contributed in establishment of COVID-19 isolation department in Center of Tropical Medicine and Infectious Diseases (CTMID), AL Thawara Public Hospital Authority, Hodeidah , Yemen ; Authors A. M. Zuhairy supported the literature review and Isra'a Al-Masrafi (M.Sc. in Microbiology) contributed to data analysis and writing of manuscript.

ETHICAL APPROVAL

The studies involving human participants were reviewed and approved by Ethics Committee of CTMID, Al-Thawara Public Hospital Authority, Hodeidah , Yemen and Tropical Medicine Center, Hodeidah University, Hodeidah, Yemen

CONSENT

Written informed consent for participation (family's death cases) was required for this study

FUNDING

This study was Funded by Center of Tropical Medicine and Infectious Diseases (CTMID), Al-Thawara Public Hospital Authority, Hodeidah , Yemen in collaboration with Health and Nutrition Program , Save the Children International (SCI) , Hodiedah Office , Yemen Country and Hayel Saeed Anam Companies Group (HAS). The publication fee is not supported in this fund.

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