

Study of COVID-19 Mortality in Comprehensive Rehabilitation Centers in Saudi Arabia

Hanan M. Hathout^{1,2,*}, Abdulmajid M. Almutairi¹, Ghada M. bin Saleh¹,
Abdulaziz A. Aldawsari³, Khalid H. Alanazi¹

¹General Directorate of Infection Prevention & Control-Ministry of Health-Saudi Arabia

²Public Health & Community Medicine Department, Faculty of Medicine, Menoufia University, Egypt

³Medical Services Administration, Ministry of Human Resources and Social Development, Riyadh, Saudi Arabia

*Corresponding author: han_hathout@yahoo.com

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Abstract Objective: Study the COVID-19 related mortality in comprehensive rehabilitation centers of Saudi Arabia. **Methodology:** Retrospective study involved review of COVID-19 infections and mortality data of all deceased patients and health care workers during the period from April to October 2020 and included data from 19 comprehensive rehabilitation centers (CRC) belongs to Ministry of Human Resources and Social Development (MHRSD) in Saudi Arabia. Collected data include: age, sex, date and direct causes of death, confirmation of COVID-19, and associated co-morbidities. For patients and health care staff, case fatality rates (CFR) were estimated and descriptive analysis of mortality was done. **Results:** During the study period, the COVID-19 CFR in the CRC was 2.25 percent and for staff was 0.37 percent, which was marginally higher than the recorded overall fatality rate for COVID-19 in Saudi Arabia during the same period. Riyadh region recorded the highest COVID-19 related deaths among patients and health care workers and most of deaths was recorded in the month of June. All deceased patients had more than one associated comorbidity and the direct cause of death was cardiac and respiratory failure. The most common associated co-morbidity was intellectual disorders. **Conclusion:** Strict COVID-19 infection control measures instituted by Ministry of Health- Saudi Arabia are successfully contributed to reduced case fatality rate in the comprehensive rehabilitation centers relative to the global rates.

Keywords: Case Fatality rate (CFR), Comprehensive Rehabilitation Centers (CRC), COVID-19, Health Care Workers (HCWs), Saudi Arabia

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1. Introduction

The COVID-19 pandemic had a significant adverse effect on residents in long term care facilities (LTCFs) affecting not only the patients, but also care staff and visitors. High infection rate in LTCFs is expected due to the fact that residents of these facilities frequently suffer from various comorbidities such as diabetes, cardiovascular diseases, chronic respiratory diseases, cerebrovascular diseases, malignancy, and dementia which were proved to be independently increase the risk of COVID-19 progression, severe outcomes, and death. Residents of LTCFs have various degrees of disability which may lead to inability to properly perform preventive health measures, such as regular hand hygiene. [1] Also, outbreaks in CRC may be explained by sharing the common sources of water, food, air, the same facilities, and the fact that there were limited number of care workers [2,3].

Many outbreaks of SARS-CoV-2 have been recorded in LTCFs worldwide since the beginning of the pandemic, impacting both residents and staff. In the United States, 35,000 confirmed deaths due to COVID-19 were reported in nursing homes, representing 42% of the total number of COVID-19 fatalities. [4] Percent of COVID-19 deaths in relation to the total COVID-19 deaths in LTCFs were also reported in Ireland (54%), France (44.6%), Belgium (42%). [5]. To our knowledge, there are no published national studies in Saudi Arabia that discuss the mortality rates due to COVID-19 in the comprehensive rehabilitation centers and compare it with the international rates and that to total COVID-19 fatality rates in Saudi Arabia.

2. Aim of Work

Study the COVID-19 mortality rates of comprehensive rehabilitation centers in Saudi Arabia.

3. Methodology

Type of study: retrospective study involved review of COVID-19 infection and mortality data of all deceased patients and health care workers due to COVID-19 in all comprehensive rehabilitation centers of Saudi Arabia during the period from April to October 2020.

Study setting: This study included reported COVID-19 data from 19 comprehensive rehabilitation centers distributed in 10 regions of Saudi Arabia and belongs to Ministry of Human Resources and Social Development (MHRSD). Patients in these centers receive basic medical services for long term and transported to hospital if they are in need of any comprehensive medical and advanced care. They are used by people who do not need to be in a hospital, but cannot be cared for at home. They are used by elderly or disabled person for receiving 24 hours' care.

Inclusion Criteria: only patients and health care workers with their direct cause of death were due to COVID-19.

Exclusion criteria: mortality reports due to any causes of death other than COVID-19.

3.1. Data Collection

Review of mortality data of CRC of Saudi Arabia since start of COVID-19 till the end of October 2020. COVID-19 infected cases are transferred to hospitals and if mortality occurred outside the centers, it is reported to the centers. Data regarding the total mortality due to COVID-19 in Saudi Arabia among patients and health care workers during the same period were obtained from world health organization and general directorates of infection prevention and control COVID-19 dashboards.

All data related to COVID-19 infection and mortality from all health sectors are recorded on the general directorates of infection prevention and control COVID-19 dashboards. Data related to CRC were extracted from the data base during the study period. Collected data include: age, sex, date and direct causes of death, confirmation of COVID-19, associated co-morbidities.

The data included mortality reports from (48) deceased patients and 10 health care workers who got the COVID-19 infection in the centers and transferred to the hospitals for emergency care and assisted ventilation. They died at hospitals either immediate in the emergency

departments or after variable period of admission in critical care units.

3.2. Confidentiality and Ethical Approval

This work was approved by the ethical committee (Institutional Review Board)- King Fahad Medical City, Riyadh. IRB log number:21-032E. All data are kept confidential and approval to collect and use data from CRC were taken from Ministry of Human Resources and Social Development, Riyadh, Saudi Arabia

3.3. Statistical Analysis

The collected data were tabulated and analyzed using Statistical Package for Social Sciences (SPSS) program version 25. Descriptive statistics including frequency, percentages, arithmetic mean (X) to analyze and describe the demographic data, and common co-morbidities. Graphical distribution of mortality by month and region to study the pattern of distribution. Case fatality rates (CFR) were calculated for patients and health care workers based on total number of COVID 19 related deaths divided by total no. COVID 19 related infections for each category in the same study period multiplied by 100.

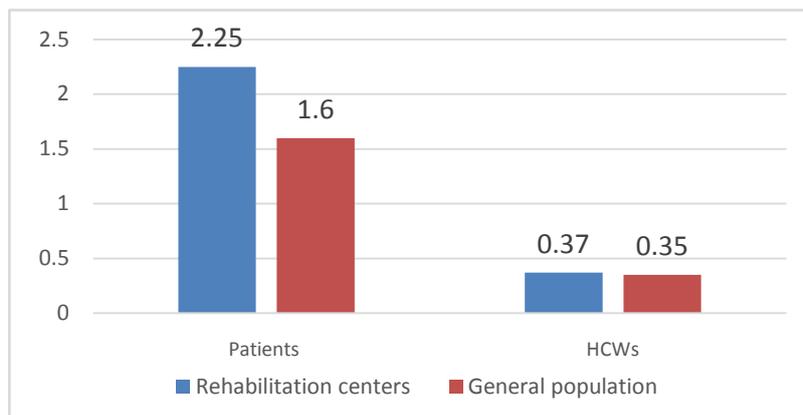
4. Results

Table 1. COVID-19 Case fatality rates for patients and health care workers in CRC during the study period

| Categories | Total no. of COVID 19 related infections N= 4822 | | Total no. of COVID 19 related deaths N= 58 | | Case Fatality rate (CFR) |
|------------|---|------|---|------|--------------------------|
| | No. | % | No. | % | |
| Patients | 2138 | 44.3 | 48 | 82.8 | 2.25% |
| HCWs | 2684 | 55.7 | 10 | 17.2 | 0.37% |
| Total | 4822 | 100 | 58 | 100 | 1.20% |

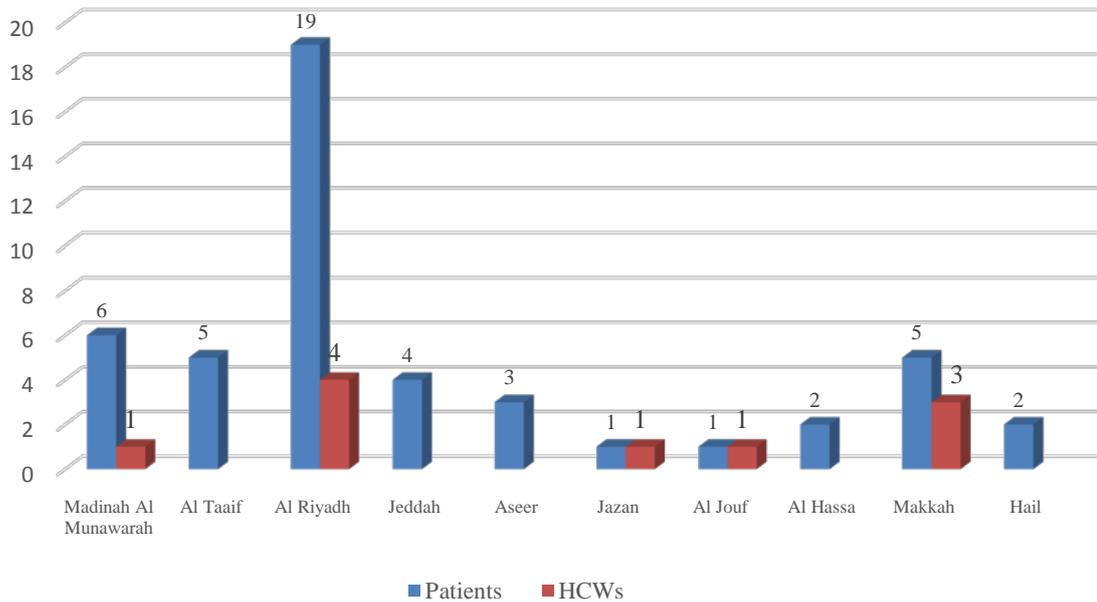
Case fatality rate for patients in the rehabilitation centers 2.25% which is higher than the rate for health care workers (0.37%). Most of COVID 19 related infections were recorded for health care workers (55.7%), while most of the related mortality was among patients (82.8%).

Figure 1. Comparison of COVID-19 Case fatality rates of patients and health care workers (HCWs) between CRC and total population



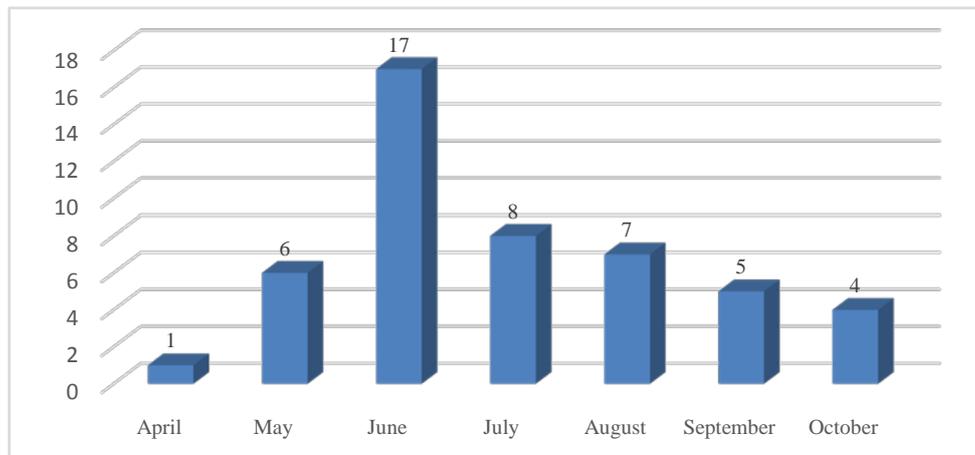
Case fatality rate for patients in comprehensive rehabilitation centers was higher than the rate in the total population which was also higher than the CFR for staff.

Figure 2. Distribution of COVID-19 Related Deaths Of Patients And Health Care Workers in The CRC By Region Of Saudi Arabia



Riyadh region recorded the large number of deaths for both patients and health care workers.

Figure 3. Distribution of COVID-19 Related Mortality among Patients in the Comprehensive Rehabilitation Centers of Saudi Arabia by Month



Most of COVID-19 related deaths among patients was recorded in June (35.4%).

Table 2. General Characteristics of Deceased Patients in CRC During the Study Period

| Characteristics (Total= 48) | | |
|---------------------------------|---------------|-------|
| Age categories | | |
| ≤ 40 | 19 | 39.6% |
| > 40 | 29 | 60.4% |
| Mean age (mean± SD) | 53 years ± SD | |
| Gender | | |
| Male | 28 | 58.3% |
| Female | 20 | 41.7% |
| Diagnosis of COVID-19 | | |
| Confirmed | 48 | 100 |
| Not confirmed | 0 | 0 |
| Direct Cause of death | | |
| Cardiac and Respiratory Failure | 48 | 100 |
| No. of co-morbidity | | |
| More than one co-morbidity | 48 | 100 |

Mean age for deceased patients was 53 years and most of them were in the age categories > 40 (60%), and Males (58%), All deceased had confirmed COVID-19 and the direct cause of death was cardiac and respiratory Failure.

Table 3. Common Associated Co-Morbidities Among Deceased Patients in Comprehensive Rehabilitation Centers

| Diseases | No. | % |
|------------------------|-----|-------|
| Diabetes | 8 | 16.7 |
| Hypertension | 10 | 20.8 |
| Kidney disease | 9 | 18.75 |
| Epilepsy | 19 | 39.6 |
| Paralysis | 10 | 20.8 |
| Intellectual disorders | 29 | 60.4 |

The most common associated co-morbidity among deceased patients was intellectual disorders (60.4%), followed by epilepsy (39.6%).

5. Discussion

The Kingdom of Saudi Arabia was one of the first countries to initiate several early, evidence-based precautionary measures at the highest levels based on their excellent experience in the risk management to ensure the safety of Hajj and Umrah pilgrims all around the year and their previous success in the management of Middle East Respiratory Syndrome (MERS-CoV). Such measures included activating Command and Control Centers (CCCs), suspending travel to China, and suspending entry to the Kingdom using tourist visas. After the first case was confirmed in the Kingdom, firm and effective precautionary measures were taken to maintain social distancing, and strengthen key capabilities and resources to combating the pandemic through an integrated national approach including the suspension of Umrah, education, and all international and domestic flights; the launch of Mass field testing; and the expansion of laboratory capacity to conduct over nine million COVID-19 tests. Also, there were a partial then total curfew in various regions of the Kingdom, and the decision to treat all citizens, legal and illegal residents for free without any consequences. [6]

These measures are reflected in better control of the disease and low mortality rates for general and specific population as in comprehensive rehabilitation centers. CFR for patients in these centers during period of study was 2.25 % (Table 1) which is markedly lower than rates recorded in many other studies as that of USA (33.7%) [7], Canada (27.8%) [8], UK (20.0 & 16.7 % in 2 different studies) [9,10], and Germany (12.5%). [11] On the other hand, study conducted in Washington to conduct surveillance for SARS-CoV-2 and describe common symptoms of COVID-19 among residents and staff of an independent/assisted living community detected only 3 cases among residents and 2 cases among staff with no reported COVID-19 mortality. [12]

In this study, the ratio of COVID-19 death in rehabilitation centers relative to the total COVID-19 death in Saudi Arabia during the study period was 0.9 as the total COVID-19 death during the same period was 5392. (Reference: WHO Coronavirus Disease (COVID-19) Dashboard). This ratio is markedly low than other studies as that of Australia as the percent of death in rehabilitation centers contribute to 66.5% of the total number of COVID-19 deaths. [13] In Belgium, COVID-19-related deaths in care home residents represented 49.6% of the total COVID-19 related death in the country. [1,14] Also, Canada, Germany show higher contribution of COVID-19 deaths from LTCFs to total COVID-19 deaths (78.2% & 39.6% respectively) [15,16]

Moreover, mortality due to COVID-19 among staff was 0.37% which is slightly higher than other study conducted in USA and detected zero mortality among staff [7], and other studies also detected zero mortality of staff in the same settings. [11,17] Low mortality rates among patients and staff in this study are largely explained by aggressive actions already have been taken by Ministry of health-Saudi Arabia to prevent introduction of COVID-19 infections in CRCs which successfully help to reduce the infection and mortality rate among the vulnerable patients at these special facilities, these actions included: dedicated

an IPC focal point at each facility to lead and coordinate infection prevention and control (IPC) activities, provide COVID-19 IPC training to all employees, provide supplies necessary to adhere to recommended infection prevention and control practices. In addition, MOH- SA took steps to maintain physical distancing in the CRCs through various measures including restrict the visitors to only absolutely necessary, cancellation of group activities, universal face masking for residents and employees, reducing the number of staff and volunteers, considering implementation of telehealth to offer remote access to care activities (whenever possible). Prospective surveillance for COVID-19 among residents, and active screening of all HCW daily at the beginning of the shift for fever and symptoms of COVID-19. [18]

Similar measures were also taken by McMichael to control COVID-19 in similar setting included visitor restrictions, twice-daily assessments of COVID-19 signs and symptoms among residents and isolation of all symptomatic residents, fever screening of all health care personnel at the start of each shift, and enforcing hand hygiene practices and use of personal protective equipment. [7] Adjusting screening criteria for COVID-19 to include altered mental status, diarrhea, and loss of appetite as common presentations in elderly populations, encouraging of broad testing, cluster care scheduling, stocking additional PPE, maintaining social distancing and suspension of group activities, and education for both staff and residents are measures taken in Washington to successful control COVID-19 in retirement communities. [19]

The strict infection prevention control management strategies applied by Saudi Authorities were very effective in containing the COVID-19 infection to the public specially the vulnerable population that lead to lowest infection rate and lowest death rates compared to other 15 different countries from which are USA and France. [20]

Despite applying the same restrictions and preventive measures across all the cities in the KSA, the incidence of COVID-19 was not similar across different cities. This may be due to differences in citizens' adherence to government restrictions. In addition, there are many differences in term of population density and diversity in the nationality of their inhabitants. Distribution of mortality in CRCs by region demonstrated that Riyadh region had the highest mortality for both patients and health care workers (Figure 2) and this corresponds to highest prevalence of infection in Riyadh as the highest percentage of new daily cases during the period from 3 March and 7 June 2020 was in Riyadh (average 24.2%), followed by Mecca (17.7%) and Jeddah (16.2%). In addition, Medina contributed an average of 12.1%, of the daily new cases based national data taken from the Saudi Ministry of Health. [21,22]

Distribution of mortality in CRCs by month demonstrated that June demonstrated the highest mortality for both patients and health care workers (Figure 3) and this again in accordance with the general increase in the death rates all over the kingdom during the same month. [21]

Male to female mortality ration in this study was 1.4 (Table 2), this finding corresponds with other published data that detected global rise in COVID-19 mortality rate

for male compared to female except in some selected countries as India. [23,24]

The explanation for gender disparity in the mortality due to COVID-19 were attributed to many factors as the biological differences in the immune systems as females are generally more resistant to infections than men, and this is likely mediated by several factors including sex hormones and high expression of coronavirus receptors (ACE 2) in men and also lifestyle, such as higher levels of smoking among men as compared to women. Women have a more accountable attitude than men towards the Covid-19 pandemic and this is reflected in better preventive measures such as regular hand hygiene, face mask use, and remaining at home. [25]

Presence of associated morbidity increase the severity and mortality among COVID-19 patients as 83.29 percent who deceased in privately insured patients had a preexisting comorbidity. [26] In this study, all the participants had more than one comorbidity included diabetes, hypertension, kidney disease, epilepsy, paralysis, and intellectual disorders (Table 2 & Table 3). All these morbid conditions can contribute to increase risk of COVID-19 and mortality rates. Intellectual disorders were the most common morbidity among deceased patients in the comprehensive rehabilitation centers in Saudi Arabia (Table 3). This finding was in accordance with other study that indicated high COVID-19 infections and mortality among those with intellectual and developmental disabilities (IDD). [27] Another study that gathered data from residential homes across New York State from the beginning of the pandemic until May 28, 2020, found that those with IDD had a higher COVID-19 infection rate (7.84 per 100,000) compared to the general population of New York State (1,91 per 100,000). Moreover, for people with IDD, the mortality rate was considerably higher than the overall rate of for the state of New York (1,175 per 100,000 & 151 per 100,000 respectively). [26]

People with intellectual disability are at greater risk of infection due to many reasons including physical health problems, social circumstances and limitations in understanding. Those people usually suffer from hereditary cardiac, inborn errors of metabolisms or respiratory conditions. The level of obesity is higher among them with greater risk of experiencing severe forms of infection with COVID-19. [27]

Diabetes and poor glucose control were attributed in many studies to be a risk factor for COVID-19-related mortality. [28,29,30] Poor glycemic control has been associated with serious infections and hospital admission and has been postulated to magnify the hyperimmune response associated with severe COVID-19. The mechanism for increased mortality are due to impaired host defenses, including granulocyte and macrophage function. [28,31]

The presence of comorbidities such as heart failure and chronic kidney disease is associated with an increased risk of hospital mortality in a population of COVID-19 patients aged 60 years and older. [32] Across all age groups, the OR for COVID-19 mortality for patients with chronic kidney disease was 1.85 and for patients with heart failure, it was 1.58 and all ratios were significant. Lack of comorbidities was partially protective against COVID-19 mortality, but not completely. [26]

Direct cause of death was cardiac and respiratory Failure (Table 2). Other study in Saudi Arabia detected 4.3% death rate with most deaths were due to ARDS and respiratory failure. [33] Study in Wuhan detected that ARDS was responsible for 53% of total COVID-19 deaths. [34] One limitation of this study is unavailable data regarding the total residents of CRC and number of working staff to calculate valid infection rates for comparison with international figures.

6. Conclusion

Strict infection control measures instituted by Ministry of health- Saudi Arabia are successfully contributed to low COVID-19 case fatality rate in the comprehensive rehabilitation centers relative to the global rates.

7. Recommendations

Continuous monitoring and implementation of infection control measures in comprehensive rehabilitation centers to control the risk of transmission of COVID-19 and other infectious diseases among the highly susceptible patients in these setting and maintain the low mortality rates. Such successful measures may be adopted by other countries with high CFR in order to achieve similar success.

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Conflict of Interest

The authors have no conflict of interest.

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