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(RESEARCH ARTICLE)

COVID-19 related deaths in Juba, South Sudan: Post mortem Audit January - July 2020

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Abstract

Background: With global spread of COVID-19, countries began to develop scientific activities ranging from detection, prevention and control measures to vaccine development. In order to develop sound strategies to mitigate COVID-19 pandemic, there is a need to conduct postmortem audit.

Objectives: The study is to determine the prevalence of COVID-19 related death in both Juba Military Referral Hospital and Juba Teaching Hospital.

Methods and materials: This is a retrospective post mortem audit study. Data related to corpses were collected from registers of both JMRH and JTH from January to July 2020.

Data was cleaned and entered in SPSS version 21 for statistical analysis and variables with $p < 0.05$ were considered statistically significant.

Results: Out of 201 corpses recorded between Jan-July, 72.6% were from JMRH, and 27.4% from JTH. Male were 76.6% and 23.4% female, Age range 21-100 years with mean of 61 years (SD+/- 17.73). Respiratory failure was the leading cause of death (26.9%) p=0.036. More than half of the corpses (52.7%) reported, died at hospital while 19.9% community death, 27.4% had no place of death indicated p=001. Furthermore 39% of the corpses were of age group (61-80 years), while 38.7% of age group (41-60 Years) died due to respiratory failure p=0.001

Conclusion: This study revealed that higher COVID-19 related death more in males with respiratory failures.

Keywords: COVID-19 related death; Respiratory failure; Post-mortem audit; Mortuary; South Sudan

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1. Introduction

With the outbreak of a novel virus of the corona virus, Corona Virus Disease 2019 (COVID-19) started by the end of 2019 in Wuhan, China. This virus then spread globally but at different period of times. Countries, through technical assistance from WHO, were encourage to carry out scientific activities including reporting of cases, prevention and control measures, vaccine development, characterization of the virus, autopsy, and innovative researches. In addition, countries were encouraged to improve on their health systems. By 31st July 2020, there were 1,7106,007 cases of COVID-19 and 668,910 deaths globally. Of these, African countries contributed about 5 % (770,421/17,106,007) of the world COVID-19 infection and 2 % (13, 234/668,910) death [1].

In South Sudan, the World Health Organization (WHO) donated PCR machines in December 2019, to the National Public Health Laboratory. This is the main National Laboratory in country involved in most of laboratory diagnosis of infectious and communicable diseases including COVID-19. It collaborates with regional laboratories in the neighboring countries. The PCRs underwent validation process till February 2020. Thus, the first PCR COVID-19 positive sample was produced on 3rd April 2020. In South Sudan, there are 0.3% (2,437/770,421) of COVID-19 cases and 0.4 % (47/13,234) death [2]. During the pandemic, almost all death bodies were transported to the mortuary for better safety and care before dignified burial by relatives of the deceased.

In Juba, the capital city of South Sudan, there are two mortuaries in Juba Military Referral Hospital (JMRH) and Juba Teaching hospital (JTH). previously, these mortuaries were of poor quality with no or poor cooling systems. JMRH was reconstructed and modernized by support from Comrade for services and catering Ltd and handed over to the administration on 17/4/2018. The mortuary now a functioning cooling room and one fridge. This mortuary has a capacity is 46 bodies. The staff consists of one forensic specialist and four mortuary staff who assist in recording and preparing the bodies for autopsy and burial. On the other hand, JTH mortuary was renovated by International Committee of Red Cross (ICRC) and handed over to the administration on 19/05/2020. The mortuary has a functioning cooling room, six fridges and three deep freezers. It has a capacity of 33 bodies. The mortuary staff consists of one forensic pathologist, one nurse and one staff who assist in recording and preparing bodies for autopsy or burial. There is a senior pathologist (with senior experience in forensic Medicine) who technically assist these two centers whenever need arises. Autopsies are preformed in these mortuaries based on the request from legal affairs office when there are the followings conditions: suspicious death where relatives are not convinced of the diagnosis; unnatural death(Homicide or Suicide or accident), and sudden death of unknown circumstances. However, autopsies are supposed to be done on regular basis. The aim for conducting autopsies are determination the exact cause of death and confirm if diagnosis made was correct or not and render a feedback, provide accurate mortality statistics to the institutions , improve public health by understanding more disease process and its causes , and assess in determination of cause of death [3].

This study intended to determine the prevalence of COVID-19 related death presented to both JMRH and JTH from January to 31st July 2020 and identify co morbidities associated with COVID-19 death. We believe this postmortem audit will help policy makers improve essential health service in the country.

2. Methodology

This was a retrospective post mortem audit study. Data of all dead bodies were collected from the registration record books from both Juba Military Referral Hospital and Juba Teaching Hospital from 1st January to 31st July 2020. Demographic data obtained included date of death, cause of death, place of death, and mortuary where the corpse was kept. Data cleaning was carried out and entered in SPSS version 21 for statistical analysis.

2.1. Statistical analysis

Data were entered, cleaned and analyzed using SPSS version 22 and displayed in form of descriptive statistics. Chi-square was used to determine the relationships between the variables. A probability level of $p<0.05$ is considered statistically significant.

2.2. Ethical Clearance

Ethical clearance was obtained from College of Medicine, University of Juba and approved by both JMRH and JTH.

3. Results

Out of 201 corpses found in both JMRH and JTH, 76.6 % (154) were males and 23.4 % (47) females with *p* value 0.169.

Table 1 Distribution of causes of death against sex and location of the corpses

S/N	Cause of death	Sex of the death		Place of Mortuary	
		Male (n)(%)	Female (n)(%)	JMRH (n)(%)	JTH (n)(%)
1	Sudden death	15(9.7)	4(8.5)	19(9.5)	0
2	Undetermined	8(5.2)	3(6.4)	11(5.5)	0
3	Heart Failure	19(12.3)	6(12.7)	25(12)	0
4	Cardiac arrest	13(8.4)	1(2.1)	14(7)	0
5	Stroke	1(0.6)	0(0)	1(0.5)	0
6	Respiratory Failure	41(26.7)	13(27.7)	54(26.9)	0
7	Pulmonary TB	3(1.9)	0(0)	3(1.5)	0
8	Pneumonia	12(7.8)	0(0)	12(6)	0
9	Ischemic Heart Disease	0(0)	1(2.1)	1(0.5)	0
10	Severe Malaria	2(1.3)	0(0)	2(1)	0
11	Diabetes Mellitus	1(0.6)	0(0)	1(0.5)	0
12	Hypertension	0(0)	3(6.4)	3(1.5)	0
13	Not indicated	39(25.3)	16(34)	0	55(100)
	Total	154(76.6)	47(23.4)	146(72.6)	55(27.4)

P=0.0

Table 2 Distribution of causes of death against place where death occurred

S/N	Cause of death	Place where death happened			Total
		Hospital (n)(%)	Community (n)(%)	Not indicated (n)(%)	
1	Sudden death	1(0.9)	18(45)	0	19(9.5)
2	Undetermined	0(0)	11(27.5)	0	11(5.5)
3	Heart Failure	23(21.7)	2(5)	0	25(12)
4	Cardiac arrest	9(8.5)	5(12.5)	0	14(7)
5	Stroke	1(0.9)	0(0)	0	1(0.5)
6	Respiratory Failure	53(50)	1(2.5)	0	54(26.9)
7	Pulmonary TB	3(2.8)	0(0)	0	3(1.5)
8	Pneumonia	9(8.5)	3(7.5)	0	12(6)
9	Ischemic Heart Disease	1(0.9)	0(0)	0	1(1.5)
10	Severe Malaria	2(1.9)	0(0)	0	2(1)
11	Diabetes Mellitus	1(0.9)	0(0)	0	1(0.5)
12	Hypertension	3(2.8)	0(0)	0	3(1.5)
13	Not indicated	0(0)	0(0)	55(100)	55(27)
	Total	106(52.7)	40(19.9)	55(27.4)	201

p=0.000

Table 3 Distribution of causes of death against COVID-19 status of the corpses in the mortuaries

S/N	Cause of death	COVID19 status			Total
		Confirmed+ve (n)(%)	Suspect (n)(%)	Confirmed-ve (n)(%)	
1	Sudden death	0(0)	15(14.3)	4(50)	19(9.5)
2	Undetermined	0(0)	11(10.5)	0	11(5.5)
3	Heart Failure	0(0)	25(23.8)	0	25(12)
4	Cardiac arrest	1(1.1)	13(12.4)	0	14(7)
5	Stroke	0(0)	1(1)	0	1(0.5)
6	Respiratory Failure	32(36.4)	21(20)	1(12.5)	54(26.9)
7	Pulmonary TB	0(0)	3(2.9)	0	3(1.5)
8	Pneumonia	0(0)	9(8.6)	3(37.5)	12(6)
9	Ischemic Heart Disease	0(0)	1(1)	0	1(1.5)
10	Severe Malaria	0(0)	2(1.9)	0	2(1)
11	Diabetes Mellitus	0(0)	1(1)	0	1(0.5)
12	Hypertension	0(0)	3(2.9)	0	3(1.5)
13	Not indicated	55(62.5)	0(0)	0	55(27)
	Total	88(43.8)	105(52.2)	8(4)	201

p=0.001

Table 4 Distribution of causes of death against age group of corpses in the mortuaries

S/N	Cause of death	Age group of corpses				Total
		20-40 yrs (n)(%)	41-60 yrs (n)(%)	61-80 yrs (n)(%)	81-100yrs (n)(%)	
1	Sudden death	7(21.9)	6(9.7)	6(7.7)	0	19(9.5)
2	Undetermined	3(9.4)	3(4.8)	4(5.1)	1(3.4)	11(5.5)
3	Heart Failure	3(9.4)	10(16.1)	7(9)	5(17.2)	25(12)
4	Cardiac arrest	2(6.3)	6(9.7)	2(2.6)	4(13.8)	14(7)
5	Stroke	0(0)	1(1.6)	0	0	1(0.5)
6	Respiratory Failure	12(37.5)	24(38.7)	15(19.2)	3(10.3)	54(26.9)
7	Pulmonary TB	0(0)	1(1.6)	2(2.6)	0	3(1.5)
8	Pneumonia	3(9.4)	3(4.8)	5(6.4)	1(3.4)	12(6)
9	Ischemic Heart Disease	0(0)	1(1.6)	0	0	1(1.5)
10	Severe Malaria	1(3.1)	1(1.6)	0	0	2(1)
11	Diabetes Mellitus	0(0)	0(0)	1(1.3)	0	1(0.5)
12	Hypertension	0(0)	0(0)	3(3.8)	0	3(1.5)
13	Not indicated	1(3.1)	6(9.7)	33(42.3)	15(51.7)	55(27)
	Total	32(16)	62(31)	78(39)	29(14)	201

Their ages ranged from 21-100 years with a mean of 61years and SD+/- 17.73. Respiratory failure 26.9% (54) was the leading cause of death followed by stroke, Ischemic Heart Disease (IHD), Diabetes Mellitus (DM) as the least, 0.5% (1), p=0.036, Table 1. Most of the corpses 72.6 % (146) were diagnosed in JMRH and 27.4 % (55) were diagnosed in JTH, Table 1. Most of the corpses 52.7 % (106) were reported death at hospital with there diagnosis, while 19.9 % (40) were brought from the community. In addition, 27.4 % (55) had no cause of death indicated, p=0.000, Table 2. Furthermore, 52.2% (105) of the corpses were suspected as COVID-19, 43.8% (88) were confirmed positive for COVID-19 while 4% (8) were confirmed negative with p=0.001, Table 3. Most of the corpses, 39 % (78), age ranged from 61- 80 years, while 38.7 % (24) of age group 41-60 years died because of respiratory failure with p=0.001, Table 44. The least affected age groups 14 % (29),were between 81-100 years and 16% (32) age group 20-40 years, p=0.001.

4. Discussion

Accurate mortality statistics are vital for improvement of health services as well as public health planning. Pomara *et al* [4] concluded that not only from death can we identify the disease but it can help us in some many ways to prevent and treat diseases. This can be achieved by conducting autopsy and regular post mortem audit in hospitals or in mortuaries. In this study, out of the 201 corpses received males (76.6%) were more than females (23.4%). This is likely to the fact that males did not adhering to prevention and control measures than females. Our finding is similar to the international literature reviewed done by Hooper with his colleagues [5] and studies by Jin *et al* [6. Out of the 20 literature review in their paper 17 articles have indicated high male to female ratio. Similar studies demonstrated that more male mortality than female during COVID-19 pandemic [7, 8, 9]. Further, Bwire in his review attributed it to higher levels of angiotensin-converting enzyme (ACE) 2 receptor, smoking and drinking habits, and imprudent conduct in males comparison to females in different parts of the world [10].

In this study, most of the death, 26.9% were from respiratory failure. This is similar to findings from autopsies done [11, 12, 13] which displayed infection of the lungs with diffused alveolar damage with cellular fibromyxoid exudates, hyaline membrane formation and pulmonary thrombosis as the main findings. Similarly, Wu *et al* in their study had shown that there was a strong relationship between increase in risk of death from COVID-19 with being of older age, cardiovascular disease, diabetes mellitus, hypertension and cancer [14]. Most of the corpses were from JMRH. This is because JMRH had a sustainable electric power as well as available human resources in comparison to JTH. In addition, it was also agreed that JMRH should be reserve for COVID-19 confirmed cases. Therefore, due to its huge capacity, most of the community deaths were brought to JMRH. Unfortunately, the corpses that were not confirmed for COVID-19 were not tested both centers. This might be due to hesitant of the relatives of the deceased in hurrying for burial or lack of policy for testing unconfirmed COVID-19 corpses. Most of the death in our study ranged from 41-60 years with respiratory failure as the leading cause. Interestingly, United Nations indicated that Sub Sahara Africa has 3% of its population with ages over 65 years. However, report from South Africa [15] in September 2020 showed that more elderly group (60-69 years) being affected. This is similar with studies done in Europe and China. This difference may be due to the variation in the months or due to fact South Africa had the highest prevalence of cases of COVID-19 in Africa. South Africa remains to have the same case fatality rate of 2 % (7,812/482,169) together with Kenya (325/19,913), Ethiopia (263/16,615) and South Sudan (46/2,322) [1]. In East Africa region, South Sudan and Kenya had the highest 2% (46/2,322) and 2% (325/19,913) respectively. We presumed that case fatality rate (CFR) for South Sudan is lower than this due to low testing capacity. Consequently, the denominator (prevalence of positive cases) remains lower in comparison to Kenya. In South Sudan, COVID-19 tests were restricted to travelers, suspected cases, and their contacts within the capital city and certain selected sentinel sites in the country. This is in contrary to Kenya where there was a high testing capacity that goes beyond testing travelers to communities in different parts of the country. In comparison neighboring countries (Kenya, Uganda, Ethiopia, Congo, Central Africa and Sudan) to South Sudan, Sudan had the highest CFR of 6.3 % (725/11,496) [1]. This might partly be attributed to having huge business with China and Egypt (CFR 5% [4,774/93,757]) that involves movement of goods and citizens between and within these countries. Moreover, the negative behavior of Sudanese community towards COVID-19 control and preventive measures might have facilitated for this high CFR. Sudan too faced weakening of the health system in respect to human resource and intensive care services since most of the highly specialized cadres have left the country for good pastures by that time.

5. Conclusion

This study revealed that higher COVID-19 related death among males than females. These deaths occurred mostly among those who have health problems such as respiratory and heart failures.

Limitations

This study is based on COVID-19 mortality reported cases two hospitals and cannot be generalized to the whole country. Inaccurate reporting and increase in cases might have negatively influenced the prediction of the real pattern of the COVID-19 related death in this study. The lack of inclusiveness of the database shown in this study limits our analyses in compiling the COVID-19 mortality rate in the country.

The COVID-19 related factors used in this study are from hospital-level data, not from the entire country. In this study, the data selected were only of a limited number of factors that potentially determine the COVID-19 mortality in both hospitals. There is a possibility of miss community death not presented to both centers.

Recommendations

Our findings indicated that there is a positive association of COVID-19 mortality with many diseases such as Respiratory and heart failures among aged population. This study is the first of its kind to be done in South Sudan. The researchers of this study have come out with the following recommendations:

- Encourage scaling up testing (surveillance), self-quarantine, compulsory facemask wearing in the public, and social distancing. This might potentially serve as an effective approach to reduce mortality rate especially among aged population with underlying health conditions.
- Ministry of Health to develop policy for routine autopsy for all dead bodies in the country to enable development of an accurate mortality statistics.
- Improve government infrastructure, effectiveness and increase test numbers to lower COVID-19 mortality rates.
- Improve capacity of government to effectively formulate and implement sound policies by the help technical experts in the field of COVID-19. Government effectiveness is essential for a long-term development outcomes, such as health facility development.
- Encourage recruitment of more middle cadres as staff in the mortuaries in order to overcome scarcity of the human resources
- Develop a unified mortuary registration book so that all important variables are captured as well as expanding and increasing the capacities of these two functioning mortuaries. This will prepare these institutions ready for any coming health disaster in the nearby future.
- Provide mortuaries with special vehicles for carrying corpses rather than using available ambulances.
- Encourage the government to fund researches in future in order to generate local data that will generate solutions for improvement and strengthening of the health care system in the country.
- Encourage Ministry of Health to develop community mortality surveillance system for reporting community-based mortality and promote prompt testing for vulnerable group (elderly and those with underlying medical conditions).
- Enhance improvement of health facilities as well as integrating COVID-19 into the health care services in all sectors of health.
- Encourage the Ministry of Health to develop ICU in main hospitals and infectious disease unit (IDU) in an international accepted standard in order to care for serious cases of COVID-19 and other diseases that need critical care in the country.
- Enhance integrated rapid response approach since we have other diseases that require a rapid response.
- Establish oxygen plants in public hospitals country wide.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflict of interest. Conceptualization, K. S, A. N, and J. L; statistical analysis, K. S; writing—original draft preparation, K. S; review and editing, C. C., A.K; I.R; and JBT. All authors have read and agreed to the published version of the manuscript.

Statement of informed consent

Since this study was a post-mortem audit in both Juba Military Refferral and Juba Teaching Hospitals mortuaries, informed consent was not obtained.

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