

Genomic Epidemiology of COVID-19 and the Inevitability of Gender Disparities Associated with the Morbidity and Mortality among Infected Patients in United States

E William Ebomoyi^{1*} and Josephine I Ebomoyi²

¹*Professor of Epidemiological Science, Department of Health Sciences, Chicago State University, Chicago, Illinois, USA*

²*Associate Professional Lecturer of Microbiology, Department of Biology, Saint Xavier University, Chicago, Illinois, USA*

***Corresponding Author:** E William Ebomoyi, Professor of Epidemiological Science, Department of Health Sciences, Chicago State University, Chicago, Illinois, USA.

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Abstract

Introduction: This study adopted epidemiologic approaches to investigate and review the out-break of COVID-19 in Wuhan China, by 2019. Data elicited from the offices of Public Health, the Federal Centers for Disease Control and Prevention and other health institutes in United States were reviewed.

Methods: This study involved, a review of the relevant scientific literature published since the outbreak of CoVID-19 by December 2019. Published statistical data were compiled from the Centers for Disease Control and prevention (CDC, USA); the National Institute of Health and the New York Office of Public Health, and other relevant public health centers in United States. From their primary data, comparisons were made on vital statistical reports on gender disparities on death emanating from COVID-19.

Results: From a very comprehensive review of the literatures, a higher frequency of mortality and morbidity rates among male subjects compared with their female counterpart was established. The inherent biological genes of females with their xx gene chromosomes probably confer better longevity and improved quality of life as a universal advantage. Published genomic epidemiologic reports substantiate the higher mortality and morbidity rates encountered from COVID-19 among males compared to their female counterpart.

Interpretation: This study has reviewed the epidemiological impact of COVID-19 as a pandemic. The epi-centers of this pandemic disease are China, United States Europe and several parts of developing nations. However, Uganda and many other East African nations experience low case fatality rate. Stringent compliance with primary prevention and the relevance of training committed contact tracers could in the near future reduce the prevalence of this pandemic.

Keywords: *Genomic Epidemiology; COVID-19; Gender Disparities; Morbidity; Mortality*

Introduction

Genomic epidemiology

The National Institute of Medicine defined, genomics as an emerging medical discipline which involves using genomic information about an individual, as a component of his or her clinical care such as diagnostic and therapeutic decision making and their health out-

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comes [1]. This innovative medical approach could enhance knowledge of new emerging infectious diseases that continue to occur sporadically, creating horrendous mortality and morbidity among numerous people worldwide.

In order to develop insights into genomics of COVID-19, it is relevant to understand how the human body consists of trillions of cells. These cells contain the entire genome. The complete sets of inherited genetic materials are encoded in deoxyribonucleic acids (DNA). During reproductive behavior, the parents' sperm and egg (DNA) combine to contribute a genome entire amount of genetic information to the fertilized embryo. Scientifically, since the same amount of genetic information is present in the cells which eventually make up an organism, humans are usually at risk of having single gene diseases inherited from parents or carry complex diseases which parents have in their genes. The U.S. Institute of Medicine (IOM) in the twenty-first century defines genomics as the "study of the entire human genome" [1]. Although male and female subjects, worldwide, were evenly exposed to the initial outbreak of COVID-19 at Wuhan in China about December 2019, yet as a result of global ecological inter-connection, the epidemiological trends associated with this pandemic have transcended Asia, North Atlantic, and other parts of the world. As a result of the morbidity and mortality associated with this pandemic, this study was designed to:

- Assess the gender disparities associated with the morbidity and mortality statistics associated with COVID-19
- Characterize the age cohort most adversely affected by COVID-19
- Illustrate the ethnic and racial disparities in the mortality and morbidity associated with COVID-19
- Assess the economic impact encountered by minority ethnic community in United States
- Advocate the succinct and relevant interventions to reduce the pain and suffering encountered by at risk ethnic groups nationwide.

Methods

This study reviewed epidemiologic data which have emerged from numerous sources since the outbreak of COVID-19 which is a pandemic. Cross-classification of data generated from The Federal Centers for Disease Control and Prevention were collected, from the Department of Public Health and other authentic sources. To accomplish data collection on mortality statistics and morbidity from COVID-19, data were acquired from federal Centers for Disease Control and Prevention, Office of public health at state level and morbidity reports from selected States in United States. To facilitate data collection, reports from The Ministry of Health of several nations was reviewed, and the morbidity and mortality statistics of some nations was also reviewed for specific international comparison. In addition to authentic online sources, we also compiled and analyzed the collected data for accuracy and authenticity. Comprehensive online websites such as <https://www.bnoews.com> through such sources as <http://bnews.com>, was reviewed. Also retrieved, were the comprehensive data from the World Health Organization (WHO) to confirm the present analysis from offices of Public Health and the National Institutes of Health, USA. Priority in data collection focused, on date of onset of COVID-19, time and date of admission to the hospital, date of proficient diagnosis of COVID-19 infection; and related demographic data such as gender, ethnicity, age and gender of the patients.

Results

Gender disparities associated with the morbidity and mortality from COVID-19

At the onset of COVID-19 outbreak in Wuhan, China, the higher mortality rate for men was quite vivid. In spite of the horror associated with COVID-19, the gender disparities observed from mortality statistics associated with the viral disease became well established. However, we must emphasize that the risk of contracting the infectious viral disease was relatively obvious by male and female patients. Based on the report from Sarah Hawkes (2), a professor of global health at the University College London; it can be said that in virtually every nation reporting mortality data, cross-classified by gender, the risk of death is higher among males who contract COVID-19 compared to their female counterparts. Table 1 is showing the age-cohort of those infected by COVID-19.

Age	Number of deaths	Share of deaths	With underlying cond	w/o underlying cond	Unknown if with underlying cond	Share of deaths of unknown w/o cond
0 - 17	9	0.06%	6	3	0	0.02%
18 - 44	603	3.9%	476	17	108	0.8%
45 - 64	3,413	22.4%	2,851	72	490	3.7%
65 - 74	3,788	24.9%	2,801	5	982	6.5%
75+	7,419	48.7%	5,236	2	2,181	14.3%
Total	15,230	100%	11,370 (75%)	99 (0.7%)	1,551 (24.7%)	25.3%

Table 1: Age of corona virus deaths.

We are collecting and analyzing the data from all US States. In the meantime, we have shown the data provided by New York City Health as of May 13, 2020.

Source New York City Health as of May 13, 2020.

For comparison, the data presented below were acquired from The New York City Health as of April 14. It can be noted that the absolute number of deaths of patients without underlying conditions was actually higher in this earlier report compared to the May 13, 2020; one, signaling the data have been since corrected and revised downward.

Age	Number of deaths	Share of deaths	With underlying cond	w/o underlying cond	Unknown if with underlying cond	Share of deaths of unknown w/o cond
0 - 17	3	0.04%	3	0	0	0
18 - 44	309	4.5%	244	25	40	1.0
45 - 64	1,581	23.1%	1,343	59	179	3.5
65 - 74	1,683	24.6%	1,272	26	385	6.0
75+	3,263	47.7%	2,289	27	947	14.2
Total	6,839	100%	5,151	137 (2.0%)	1,551	24.68%

Table 2: April 14 data.

Source: <https://www.worldometers.info/coronavirus-age-sex-demographics/>.

Gender	Deaths	Share of deaths	With underlying condition	Share within this category	W/o underlying condition	Share within this category	Unk. If with condition	Share within this category
Male	4,095	61.8%	3,087	62.2%	96	72.2%	912	59.5%
Female	2,530	38.2%	1,873	37.8%	37	27.8%	620	40.5%

Table 3: Gender ratio.

Data provided by New York City Health as of April 14, for known sex of deceased.

Source: <https://www.worldometers.info/coronavirus-age-sex-demographics/>.

Age	Death rate confirmed cases	Death rate all cases
80+ years old	21.9%	14.8%
70 - 79 yrs old		8.0%
60 - 90		3.6%
50 - 59		1.3%
40 - 49		0.4%
30 - 39		0.2%
20 - 29		0.2%
10 - 19		0.2%
0 - 9		No fatalities

Table 4: Age cohort of coronavirus deaths.
COVID-19 fatality rate by age.

*Death Rate = (number of deaths/number of cases) = probability of dying if infected by the virus (%). This probability differs depending on the age group. The percentage shown below do not have to add up to 100%. As they do NOT represent share of deaths by age group. Rather, it represents, for a person in a given age group, the risk of dying if infected with COVID-19.

*Death Rate = (number of deaths/number of cases) = probability of dying if infected by the virus (%). The percentages do not add up to 100%, as they do NOT represent the share of deaths by age group.

Source: <https://www.worldometers.info/coronavirus-age-sex-demographics/>.

Pre-existing condition	Death rate confirmed cases	Death rate all cases
Cardiovascular disease	13.2%	10.5%
Diabetes	9.2%	7.3%
Chronic Resp. Dis.	8.0%	6.3%
Hypertension	8.4%	6.0%
Cancer	7.6%	5.6%
No pre-existing conditions		0.9%

Table 5: COVID-19 fatality rate by comorbidity.

*Death Rate = (number of deaths/number of cases) = probability of dying if infected by the virus (%). This probability differs depending on pre-existing condition. The percentage shown below does NOT represent in any way the share of deaths by pre-existing condition. Rather, it represents, for a patient with a given pre-existing condition, the risk of dying if infected by COVID-19.

*Death Rate+ (number of deaths/number of cases) = probability of dying if infected by the virus (%). The percentages do not have to add up to 100%, as they do NOT represent share of deaths by condition.

Source: <https://www.worldometers.info/coronavirus-age-sex-demographics/>.

Gender	Death rate confirmed cases	Death rate all cases
Male	4.7%	2.8%
Female	2.8%	1.7%

Table 6: Gender ratio: COVID-19 fatality rate by gender.

**Death Rate = (numbers of deaths/number of cases) = probability of dying if infected by the virus (%). This probability differs depending on gender. When reading these numbers, it must be taken into account that smoking in China is much more prevalent among males. Smoking increases the risks of respiratory complications [3].*

**Death Rate= (number of deaths/ number of cases) = probability of dying if infected by the virus (%). The percentage do not have to add up to 100%, as they do NOT represent share of deaths by gender. Pre-existing medical conditions (co-morbidities).*

Patients who reported no pre-existing (“comorbid”) medical conditions had a case fatality rate of 0.9%. Pre-existing illness that put patients at higher risk of dying from a COVID-19 infection include: diabetes, heart disease and cancer.

Source: <https://www.worldometers.info/coronavirus-age-sex-demographics/>.

Discussion

This epidemiological study focuses on unpredictable, COVID-19 which is a pandemic viral disease. This disease is associated with high mortality and morbidity among infected patients worldwide. At the initial outbreak of this pandemic, very limited interventional strategies were known about the virulent nature and the associated case-fatality and morbidity rates associated with this disease. By the advent of 2020 winter season, COVID-19 had infected several developed and developing nations with overwhelming, morbidity and mortality rates worldwide. At the early phase of onset of COVID-19, virologists, clinical epidemiologists, and other healthcare personnel continued to investigate interventions to combat this lethal viral disease, and analyze gender disparities which could be associated with the mortality and morbidity of COVID-1 [4,5].

As summarized in table 1, patients infected by COVID-19 were few in the cohort of 0 - 17. Besides, there was a higher frequency of those in the age-group of 50 and above. From table 2, the observed frequency demonstrates those predominantly infected by COVID-19. These are patients in the age groups of forties and above [5].

As illustrated in table 4 and 5, the mortality statistics reported on COVID-19 revealed the preponderance of elderly males in their fifties and above. These patients were most at risk of getting infected by COVID-19; and they were more exposed to the numerous symptoms associated with the disease. Genome Epidemiologists and virologists have confirmed that coronaviruses are the largest, enveloped, single-stranded positive-sense RNA viruses, including four genera: Alphacoronavirus, Betacoronavirus, Gammacoronavirus, and Deltacoronavirus, Alpha- and Betacoronavirus which mainly infect mammals, the rest of the other two mainly infect birds [5].

The United States Center For Disease Control and Prevention, (CDC) has recommended that at risks cohorts to be meticulous in protecting themselves against such classical signs and symptoms which could appear within two to four days which are indicators of the incipient stage of COVID-19. These symptoms include: fever, chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, new loss of a taste of smell, sore throat, congestion or running nose, nausea or vomiting and sporadic diarrhea [6]. By far most critical, is the predominant case fatality rate among male patients which outnumbers the death and disabilities observed in their female counterpart.

Gender differences in longevity and clinical response to COVID-19

From genomic epidemiological studies, the inherent biologic genes of females with their XX gene chromosomes confer better longevity and improved quality of life as a universal advantage. However, in many developing nations, their male counterparts develop and modify human cultural attributes just to compensate for their biological disadvantages [6]. Curley, *et al.* [7] substantiate the present finding that more males are dying from COVID-19 than females. They also reported that males tend to engage in more risky behavior such as ignoring physical distancing, and they do not take the symptoms of COVID-19 seriously. Besides, some of the other underlying reasons why more males die from COVID-19 are basically, the higher frequency of underlying diseases as heart disease in men, high-blood pressure and other chronic and degenerative diseases which are common in most males. Finally, Reeves and Ford [8] have emphasized that although both male and female face the same predicament, yet males are more exposed to higher risk of death than their female counterpart across United States and in fact, other parts of the world. As reported in England and Wales, to illustrate, male social (care) workers are dying from COVID-19 at a higher rate of 23.4 deaths per 100,000 compared to a rate of 9.6% for their female counterparts [8]. In fact, Marais, *et al.* [9] have emphasized from their comprehensive analysis of the Calabrian (South Italy) population that there are twice as many women as men in their cohort of centenarians. Besides, the over representation of women in their very late age cohort has been observed for a long time [9]. Ebomoyi [6] in his *Globalization Health and Human Rights*, Kendall Hunt Press, emphasized the genomic attributes of female complimentary XX alleles as the unique female advantage in enhancing the longevity of our female counterpart compared to the heterozygote XY male alleles which neither enhance male's longevity, nor fortify males' genomic composition to combat new emerging infectious disease such as COVID-19, Ebola viral disease, or even smallpox.

Knowledge of the virulence of this pandemic COVID-19, must be taken into cognizance at the time of individuals' clinical diagnosis to emphasize compliance with the relevant interventions to ensure that COVID-19 is aggressively treated at the incipient stages of the disease. Besides, compliance with comprehensive clinical interventions at the early phase or onset of COVID-19, can be most useful in the treatment of at risk patients irrespective of the gender infected [10,11].

Conclusion

Since COVID-19 is a new, emerging viral disease, very strict compliance with the primary preventive strategies recommended by CDC and other authentic health institutions worldwide are required to protect humankind from getting infected with this virulent infectious agent, which has a relatively high case fatality rate. To ensure we protect ourselves and others from getting infected, we must constantly wash our hands thoroughly and apply alcohol hand sanitizer to ensure effective protection. Constant, thorough washing of hands and application of alcohol hand sanitizers should ensure the protection of at risk individuals. Sick employees are advised to stay at home to prevent the transmission of the disease to unsuspecting co-workers. As a result of the higher risk of mortality among males from COVID-19, very strict compliance is required for primary prevention of this lethal pandemic. Individuals with underlying chronic diseases are particularly at more risk of getting infected; therefore, compliance with primary preventive strategies against COVID-19 should not be trivialized.

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