

**Original Article****Open Access****Demographic attributes of COVID-19 patients in an Infectious Disease Center of Nigeria**

\*<sup>1</sup>Arinola, G. O., <sup>2</sup>Fashina, O. A., <sup>3</sup>Oluyomi Ishola, O. C., <sup>2</sup>Akinbola, O. I., <sup>4</sup>Akinbile, S. A., <sup>4</sup>Egunjobi, A. O., <sup>5</sup>Bello, M. D., <sup>1</sup>Edem, F. V., <sup>1</sup>Rahamon, S. K., <sup>6</sup>Famuyiwa, O. I., <sup>7</sup>Olaoti, A. J., <sup>8</sup>Olaniyan, O. A., <sup>5</sup>Oke, A. C., <sup>10</sup>Fowotade, A., <sup>11</sup>Abimbola, O., <sup>5</sup>Johnson, J. O., <sup>5</sup>Fagbemi, O. S., <sup>9</sup>Salami, F., and <sup>5,12</sup>Alonge, T. O.

<sup>1</sup>Department of Immunology, College of Medicine, University of Ibadan, Ibadan

<sup>2</sup>Department of Medical Microbiology, University College Hospital, Ibadan

<sup>3</sup>National Blood Transfusion Service, Total Garden, Ibadan

<sup>4</sup>Central Diagnostic Centre, Total Garden, Ibadan

<sup>5</sup>Infectious Disease Centre, Olodo, Ibadan

<sup>6</sup>Department of Chemical Pathology, University College Hospital, Ibadan

<sup>7</sup>General Hospital, Igboho

<sup>8</sup>Department of Chemical Pathology, Ladoke Akintola University of Technology, Ogbomoso

<sup>9</sup>Oyo State Ministry of Health, Ibadan

<sup>10</sup>Department of Medical Microbiology, University of Ibadan

<sup>11</sup>Department of Medicine, University College Hospital, Ibadan

<sup>12</sup>Department of Surgery, College of Medicine, University of Ibadan, Ibadan

\*Correspondence to: [drarinolaog64@yahoo.com](mailto:drarinolaog64@yahoo.com); +234 80-23451520; ORCID number: 0000-0001-7901-1498

**Abstract:**

**Background:** As part of our contribution to the growing pool of knowledge on the prevention and control of the COVID-19 pandemic, this study describes the demographic features of patients with COVID-19 hospitalized at Infectious Disease Center (IDC), Olodo, Ibadan, Oyo State, Nigeria.

**Methodology:** This was a descriptive cross-sectional study of COVID-19 patients whose data were collected during admission between April 27, 2020 and June 20, 2020. SARS-CoV-2 infection was diagnosed on nasopharyngeal specimen using a real-time reverse transcription-polymerase chain reaction (rRT-PCR) assay. Data were analysed using the Statistical Package for Social Sciences (SPSS Inc., USA) version 20.0

**Results:** Among 131 patients, 58% were between age 18 and 35 years, 48.1% were employees of private establishments, and 64.1% were males. High proportion (84.3%) of the patients spent less than 14 days on admission. As at June 20, 2020, the overall COVID-19 mortality in the IDC was 0.0%.

**Conclusion:** This study concluded that COVID-19 was common among male Nigerians, those working in private establishments, and those aged 18-35 years. Future researches on COVID-19 in Nigeria must put gender and age into consideration.

**Keywords:** SARS-COV2; COVID-19; age; gender; occupation

Received Aug 16, 2020; Revised Aug 21, 2020; Accepted Aug 28, 2020

Copyright 2021 AJCEM Open Access. This article is licensed and distributed under the terms of the Creative Commons Attribution 4.0 International License <http://creativecommons.org/licenses/by/4.0/>, which permits unrestricted use, distribution and reproduction in any medium, provided credit is given to the original author(s) and the source. Editor-in-Chief: Prof. S. S. Taiwo

**Attributs démographiques des patients atteints de COVID-19 dans un centre de maladies infectieuses du Nigéria**

\*<sup>1</sup>Arinola, G. O., <sup>2</sup>Fashina, O. A., <sup>3</sup>Oluyomi Ishola, O. C., <sup>2</sup>Akinbola, O. I., <sup>4</sup>Akinbile, S. A., <sup>4</sup>Egunjobi, A. O., <sup>5</sup>Bello, M. D., <sup>1</sup>Edem, F. V., <sup>1</sup>Rahamon, S. K., <sup>6</sup>Famuyiwa, O. I., <sup>7</sup>Olaoti, A. J., <sup>8</sup>Olaniyan, O. A., <sup>5</sup>Oke, A. C., <sup>10</sup>Fowotade, A., <sup>11</sup>Abimbola, O., <sup>5</sup>Johnson, J. O., <sup>5</sup>Fagbemi, O. S., <sup>9</sup>Salami, F., and <sup>5,12</sup>Alonge, T. O.

<sup>1</sup>Département d'immunologie, Collège de médecine, Université d'Ibadan, Ibadan

<sup>2</sup>Département de microbiologie médicale, Hôpital Universitaire, Ibadan

<sup>3</sup>Un service nationale de transfusion sanguine, Jardin total, Ibadan

<sup>4</sup>Centre de diagnostic central, Jardin total, Ibadan

<sup>5</sup>Centre des maladies infectieuses Ibadan, Olodo, Ibadan

<sup>6</sup>Département de chimie Pathologie, Hôpital Universitaire, Ibadan

<sup>7</sup>Hôpital général, Igboho

<sup>8</sup>Département de pathologie chimique, Université de technologie Ladoké Akintola, Ogbomoso

<sup>9</sup>Ministère de la Santé de l'État d'Oyo, Ibadan

<sup>10</sup>Département de microbiologie médicale, Université d'Ibadan

<sup>11</sup>Département de médecine, Hôpital Universitaire, Ibadan

<sup>12</sup>Département de chirurgie, Collège de médecine, Université d'Ibadan, Ibadan

\*Correspondance à: [drarinolaog64@yahoo.com](mailto:drarinolaog64@yahoo.com); +234 80-23451520; Numéro ORCID: 0000-0001-7901-1498

## Abstrait:

**Contexte:** Dans le cadre de notre contribution au pool croissant de connaissances sur la prévention et le contrôle de la pandémie COVID-19, cette étude décrit les caractéristiques démographiques des patients atteints de COVID-19 hospitalisés au Centre des maladies infectieuses (IDC), Olodo, Ibadan, État d'Oyo, Nigéria.

**Méthodologie:** Il s'agissait d'une étude transversale descriptive de patients atteints de COVID-19 dont les données ont été collectées lors de l'admission entre le 27 avril 2020 et le 20 juin 2020. L'infection par le SRAS-CoV-2 a été diagnostiquée sur un échantillon nasopharyngé à l'aide d'une transcription inverse en temps réel-Test de réaction en chaîne par polymérase (rRT-PCR). Les données ont été analysées à l'aide du Statistical Package for Social Sciences (SPSS Inc., USA) version 20.0

**Résultats:** Parmi 131 patients, 58% avaient entre 18 et 35 ans, 48,1% étaient des employés d'établissements privés et 64,1% étaient des hommes. Une forte proportion (84,3%) des patients ont passé moins de 14 jours à l'admission. Au 20 juin 2020, la mortalité globale par COVID-19 dans l'IDC était de 0,0%.

**Conclusion:** Cette étude a conclu que le COVID-19 était courant chez les hommes Nigériens, ceux travaillant dans des établissements privés et ceux âgés de 18 à 35 ans. Les futures recherches sur le COVID-19 au Nigéria doivent prendre en compte le sexe et l'âge.

**Mots clés:** SRAS-COV2; COVID-19; âge; le sexe; occupation

## Introduction:

Coronavirus disease-2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus-2 (SARS-COV2) is a viral disease that is of great global public health concern. Coronavirus (COV) is one of the major viral pathogens that primarily targets the human respiratory system. Person-to-person transmission of coronaviruses occurs primarily via direct contact or through droplet spread when an infected individual coughs or sneezes (1). The binding of the receptor-binding domain (RBD) of the virus spike proteins to the host angiotensin converting enzyme-2 (ACE2) cellular receptor, fuses SARS-COV-2 with the host cellular membrane (2,3) to initiate and establish the disease. Therefore, measures to reduce person-to-person transmission of SARS-COV-2 in COVID-19 needs to be implemented to control the current pandemic through primary protection particularly of the susceptible populations such as the elderly, children, health care providers, and people with underlying medical conditions (1).

The symptoms of COVID-19 appear after an incubation period of approximately 5.2 days while the period from the onset of COVID-19 symptoms to death ranged from 6 to 41 days with a median of 14 days, but this is highly dependent on the age of the patient and status of the patient's immune system (4). This period has been reported to be shorter among patients above 70 years of age compared to those under the age of 70 years (4). These findings underscore the need to

have a good understanding of the demographic profiles of COVID-19 patients in different populations.

The chronology of coronavirus infections in Nigeria as revealed by the Federal Ministry of Health was that the first confirmed case of COVID-19 in Lagos State, Nigeria was registered on the 27th of February 2020, although the outbreak in China began in January 2020 (5). On 21st March 2020, the first case of COVID-19 was confirmed in Ibadan, Oyo State, Nigeria which brought the tally of confirmed COVID-19 cases in Nigeria at that time to 23 (6). By the 30th of July 2020, Oyo State had a total 2,713 laboratory confirmed cases, 1,451 cases on admission at various isolation homes or health outposts, 1,259 cases had been discharged, and 27 deaths recorded (case fatality rate of 0.99%). In Nigeria as a whole on the same date, there were 42,689 confirmed cases, 22,331 active, 19,270 discharged, and 878 deaths (case fatality rate of 2.05%) (7).

According to a previous study, social and economic factors were reported to have potential impact on infectious disease dynamics (8). Fang et al., (9) reported that medical staff density had significant positive influence on occurrence of SARS infection in mainland China. School education and living conditions were associated with hospitalization during the 2009 H1N1 influenza pandemic (10). Through respiratory droplets as the major means of transmission of SARS-COV-2, COVID-19 now spreads easily and sustainably in the Nigerian community (11,

12), and previous studies have opined that socio-economic factors such as occupation might have impacts on the COVID-19 spread.

Symptomatic COVID-19 patients are usually managed in isolation centers where varied management modalities including supportive and definitive therapies are administered. One of such centers in Oyo State is the Infectious Disease Center located in Olodo, Ibadan, Nigeria. This study describes the demographic characteristics of COVID-19 patients treated at the center over a period of approximately two months.

## Materials and method:

### Study setting

The study was conducted in Ibadan, the capital city of Oyo State, Nigeria, located about 100 miles (160 km) from the Atlantic coast. It is one of the most populous cities in the country and the economic activities of Ibadan include agriculture, commerce, handicrafts, manufacturing, and service industries. Ibadan is an important commercial centre having many markets.

### Study design, subjects and data collection

This was a descriptive cross-sectional study of a total of 131 patients with COVID-19 treated at the Infection Disease Center (IDC), Olodo, Ibadan, who were enrolled into the study between April 27, 2020 and June 20, 2020. The COVID-19 cases with clinical symptoms of dry cough, high fever, sore throat and/or shortness of breath, were confirmed by detection of SARS-COV2 nucleic acid using real-time reverse-transcriptase polymerase chain reaction (rt-PCR) assay on

nasal and pharyngeal swab specimens following recommended guidelines (13).

Data were collected using pre-tested questionnaire which contains information on age, gender, pre-existing conditions, occupation and level of education. The date of admission was subtracted from the day of discharge to obtain the number of days on admission. Before the commencement of the study, the approval (UI/EC/20/0233) was obtained from the University of Ibadan/ University College Hospital (UI/UCH) Joint Ethics Review Committee. In addition, informed consent was obtained from the study participants.

### Statistical analysis

Data obtained were analysed using Statistical Package for Social Sciences (SPSS Inc., USA) version 20.0 and the descriptive analyses of data were presented as frequency and percentages.

## Results:

The demographic characteristics of the 131 COVID-19 participants are shown in Table 1. High frequencies of the participants were between the ages of 18 and 35 years (58%), were largely employees of private establishments (48.1%), and mostly males (64.1%). One patient each had hypertension, diabetes mellitus, sickle cell anaemia and stroke, as underlying medical conditions. A high percentage (84.3%) of the patients spent less than 14 days on admission, and mortality was 0.0% during the period of study. The number of patients admitted and discharged increased weekly till week 4 and 5 respectively in the center (Fig 1).

Table 1: Demographic characteristics of COVID-19 patients in Infectious Disease Center (IDC), Olodo, Ibadan, Nigeria

Characteristic variables	Frequency (n=131)	Percentage
<b>Age group (years)</b>		
<18 years	4	3.1
18-35 years	76	58.0
36-55 years	36	27.5
>55 years	15	11.5
<b>Gender</b>		
Male	84	64.1
Female	47	35.9
<b>Occupation</b>		
Unemployed	20	15.3
Self employed	28	21.4
Private Companies	63	48.1
Civil servant	20	15.3
<b>Days on admission of 96 discharged patients</b>		
≤7 days	8	8.3
8-14 days	73	76.0
>14days	15	15.6
<b>Co-morbidities (n=4)</b>		
Stroke	1	0.7
Hypertension	1	0.7
Sickle cell anaemia (HbSS)	1	0.7
Diabetes mellitus	1	0.7
<b>Mortality rate at IDC, Olodo, Ibadan</b> (April 27- June 20, 2020)	0	0.0

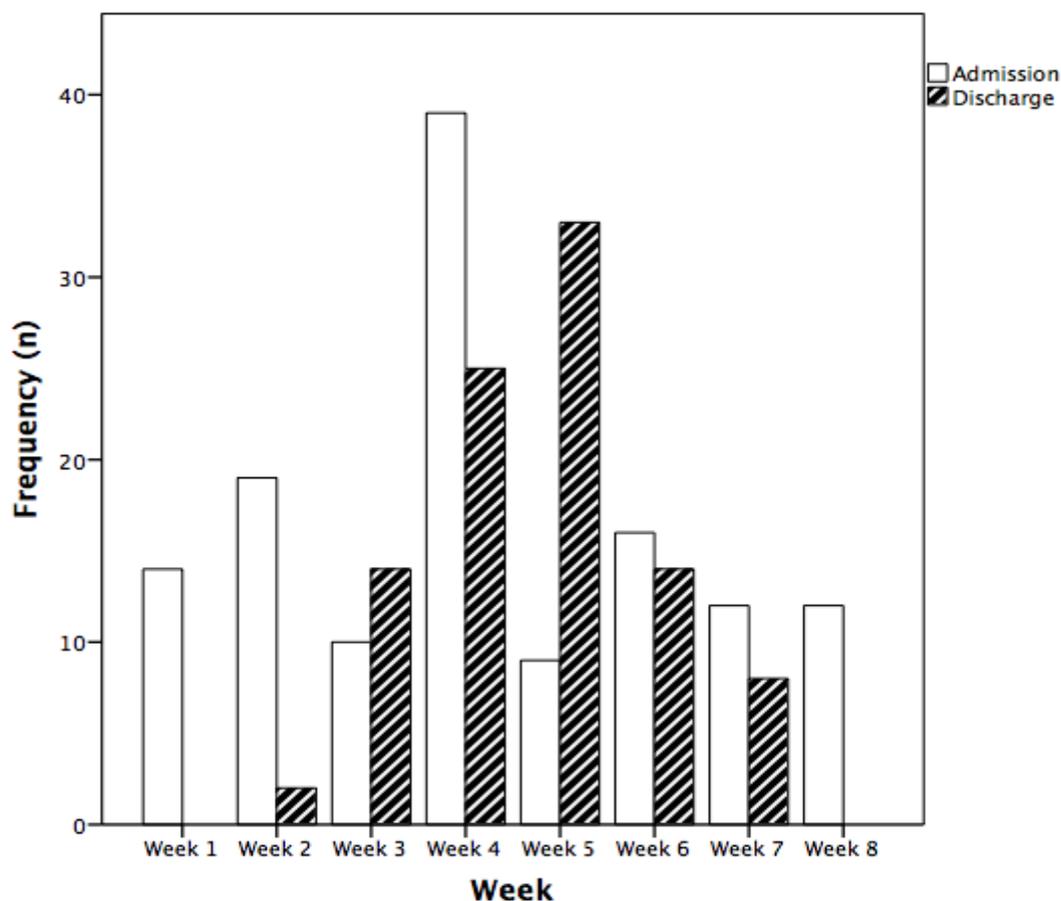


Fig 1: Weekly distribution of admission and discharge rates in Infectious Diseases Center, Olodo, Ibadan, Nigeria

## Discussion:

SARS-CoV-2 belongs to RNA family of coronavirus causing severe respiratory diseases in humans (14). Epidemiological studies show that the SARS-CoV-2 is more contagious than SARS-CoV but its lethality is said to be less than that of SARS or MERS (1,15-18). However, the mortality of COVID-19 outbreak is still relatively high and the pandemic is ongoing in several countries of the world. The World Health Organization (WHO) on March 10, 2020 reported mortality rates for COVID-19 of 3.88% in China, 5.05% in Italy, 4.03% in the United States, 0.75% in South Korea, 3.81% in Iran, 2.73% in Spain, 2.14% in France, 1.75% in Japan, 0.93% in Britain, and 0.18% in Germany (1,15-18). As at July 30, 2020, Oyo State in southwest Nigeria had reported 27 COVID-19 related deaths out of 2,713 laboratory confirmed cases (case fatality rate of 0.99%), and 1,259 discharges (19). On the same date, Nigeria recorded 878 COVID-19 related deaths out of a total of 42,689 confirmed cases (case fatality rate of 2.05%), with 19,270 discharges.

The predominant age-group affected, according to the Nigeria Center for Disease

Control (NCDC) data was 31 to 40 years, and in relation to gender distribution, males were more frequently infected than females. With the increasing number of confirmed cases in the country, the NCDC believed that in the absence of a vaccine, compliance with infection prevention and control (IPC) measures remains the most effective intervention to control the COVID-19 pandemic (20). Also, many experts believed that SARS-CoV-2 may coexist with humans for a long time (15), therefore, special attention should be paid to potential COVID-19 infection risks (21). Tracking the epidemiological attributes of COVID-19 patients in each locality will hence be highly required.

In this study, a higher proportion of patients with COVID-19 were males within the active age of 18 and 35 years. This observation supports the report that the most affected age groups in Nigeria are those in 31 to 40 years group (22). Sun et al., (23) also reported similar observation in a part of China. This observation could be due to high outdoor activities in males within this age group which could increase their risks of contracting the virus. Most people in this age group are either in schools, unemployed or engaged in

available petty employment such as selling, driving commercial bicycle, tricycle or taxis. Thus, this group of people are prone to contacting SARS-COV-2 especially when they do not adhere to infection prevention and control measures.

Data from some countries showed similar numbers of COVID-19 cases in women and men, but an increased case fatality in men (24,25). In our study however, no death was recorded for either male or female COVID-19 patients during the study period, but the infection rate was 64.1% in the males compared to 35.9% in the females. Genetics and sex hormone differences determine susceptibility and response to viral infections between males and females, which may be responsible for the gender differences in the incidence and severity of COVID-19 in our study and those of others (26). It has also been reported that exposure to influenza A viruses is often higher in males than females but fatality following exposure is reportedly higher in females (27). The adaptive immune responses to viral infections differ between males and females (28). In the studies by Boissier et al., (29), Xia et al., (30) and Melgert et al., (31), the number and activity of innate immune cells were reportedly higher in females than in males.

In this study, the frequency of COVID -19 was highest among patients working in private companies (48.1%), followed by the unemployed (21.4%). Most of the patients working in private companies are staffs who have to adhere strictly to the rule and regulations of the employers or face the threat of sack. In private companies, gain is maximised and staff are paid based on work done. The high frequency of the disease among the unemployed group may be due to the fact that they are freely mobile in search of means of livelihood. Moreover, this group have limited resources and may have no fund to purchase face masks and hand-sanitizers needed to comply with COVID-19 preventive measures. Some of the them may also have some degrees of immuno-compromise from poor or malnutrition.

Because economic activities are closely related to human behaviour (32,33), they have impacts on the COVID-19 morbidity and mortality (8), which as a result of competition for scarce resources, could facilitate SARS-COV2 transmission via respiratory droplets and contacts. The transmission of COVID-19 via droplets and fomites is greatly enhanced by close contact between infectors and infectees (34). Ecological, biological, and social factors greatly influence infectious diseases dynamics (35). Some social and economic factors that change human behaviour also present challenges for prevention and

control of infectious diseases (36), including COVID-19. The development of the tertiary industry and retail sales needs large number of proprietors and consumers. Areas with total retail sales of consumer goods per unit of the land area indicate that people prefer to purchase in the market in these areas. These influencing factors lead to the risk of the transmission of COVID-19 in the commercial activity as seen in our study which showed that private workers were more frequently infected.

The number of admissions increased from the beginning of our recruitment. This was due to a number of factors such as; increased community transmission, increased numbers of screening centers, initial stigma related to COVID-19 had largely been ignored by the populace which aided voluntary reporting to screening centers, massive education, and enlightenment of the populace with a clear message that COVID-19 was not a "death-sentence". There was no case of COVID-19 re-infection in the center during the period of the study, while the number of discharged cases increased weekly. This observation may have been related to effective management, and non-fatal nature of SARS-COV-2 strain, which may be responsible for the mild nature of the COVID-19 disease without complications, seen in most of the patients at the time of admission. These may also account for zero mortality rate of COVID-19 cases in the center during this period.

The COVID-19 symptoms have been reported to resolve after about 10 days (37). However, viral shedding may continue in spite of symptoms disappearance (37,38), and COVID-19 RNA viral shedding can persist for about 18 days in the nasopharynx or 19 days in the faeces (39). Mild and asymptomatic cases tend to shed the virus for 10 days (8–15 days) after symptom resolution (40), with 90% resolving after 10 days and nearly all cases resolving after 15 days (38). These observations were consistent with findings in our center where most of our patients stayed between 8 and 14 days on admission. However, multi-centered studies will be required to have a better understanding of the dynamics of the COVID-19 pandemic with regards to demography, disease burdens (mortality and morbidity) and risk factors associated with different stages of COVID-19.

## Conclusion:

In conclusion, our study showed that COVID-19 was more frequent among male Nigerians, those working in private establishment and those in active age group (18-35 years), thus providing ideal about the likely

SARS-CoV-2 reservoir populations to be targeted for control measures in the ongoing COVID-19 pandemic in Nigeria. Our findings also emphasised the impact of age, occupation and gender on the incidence or case fatality of COVID-19, thus tailoring treatment accordingly or giving the basis for further studies, which should put gender and age analyses into consideration.

## Acknowledgments:

The authors wish to appreciate the Oyo State COVID-19 Task Force ably led by the Executive Governor, Engineer Seyi Makinde FNSE, for the comprehensive program set up to combat the COVID-19 pandemic.

## Conflicts of interest:

No conflict of interest is declared.

## References:

- Chan, J. W., Yuan, S., Kok, K. H., To, K. W., Chu, H., Yang, J., and Yuen, K. Y. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: A study of a family cluster. *The Lancet*. 2020; 395 (10223): 514 – 523. [https://doi.org/10.1016/S0140-6736\(20\)30154-9](https://doi.org/10.1016/S0140-6736(20)30154-9)
- Lippi, G., and Henry, B. M. Active smoking is not associated with severity of coronavirus disease 2019 (COVID-19). *Eur J Intern Med*. 2020; pii: S0953-6205(20)30110-2. [10.1016/j.ijim.2020.03.01](https://doi.org/10.1016/j.ijim.2020.03.01)
- Pinheiro, D. S., Santos, R. S., Jardim, P. C. B. V., et al. The combination of ACE I/D and ACE2 G8790A polymorphisms reveals susceptibility to hypertension: a genetic association study in Brazilian patients. *PLoS One*. 2019; 14 (8): e0221248.
- Guan, W. J., Ni, Z. Y., Hu, Y., et al. Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med*. 2020; doi: 10.1056/NEJMoa2002032. <https://ncdc.gov.ng/news/227>
- <https://www.pulse.ng/news/local/oyo-confirm.....>
- <https://covid19.ncdc.gov.ng>
- You, H., Wu, X., and Guo, X. Distribution of COVID-19 Morbidity Rate in Association with Social and Economic Factors in Wuhan, China: Implications for Urban Development. *Int J Environ Res Publ Hlth*. 2020; 17: 3417. doi:10.3390/ijerph17103417.
- Fang, L. Q., De Vlas, S. J., Feng, D., et al. Geographical spread of SARS in mainland China. *Trop Med Int Hlth*. 2009; 14: 14–20.
- Lowcock, E. C., Rosella, L. C., Fois, J., McGeer, A., and Crowcroft, N. The social determinants of health and pandemic H1N1 2009 influenza severity. *Am J Publ Hlth*. 2012; 102: e51–e58.
- Chan, J. F., Yuan, S., Kok, K. H., et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet*. 2020; 395: 514–523.
- Chen, D., Xu, W., Lei, Z., Huang, Z., Liu, J., Gao, Z., and Peng, L. Recurrence of positive SARS-CoV-2 RNA in COVID-19: A case report. *Int J Infect Dis*. 2020; 93: 297–299.
- Li, T. 2020. Diagnosis and clinical management of severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) infection: an operational recommendation of Peking Union Medical College Hospital (V2.0). Working Group of 2019 Novel Coronavirus, Peking Union Medical College Hospital. 2020: 582–585. <https://doi.org/10.1080/22221751.2020.1735265>
- Ma, Y. L. Research progress on the characteristics of coronavirus and its pathogenesis to human. *Chin J Clin Infect Dis*. 2018; 11: 305–315.
- Gates, B. Responding to Covid-19-A Once-in-a-Century Pandemic? *N Engl J Med*. 2020; 382: 1677–1679.
- Pullano, G., Pinotti, F., Valdano, E, et al. Novel coronavirus (2019-nCoV) early stage importation risk to Europe, January 2020. *Euro Surveill*. 2020;25(4):pii=2000057. <https://doi.org/10.2807/1560-7917.ES.2020.25.4.2000057>
- Gralinski, L. E., and Menachery, V. D. Return of the Coronavirus: 2019-nCoV. *Viruses*. 2020; 12 (2): 135. <https://doi.org/10.3390/v12020135>
- Riou, J, and Althaus, C. L. Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. *Euro Surveill*. 2020; 25 (4): pii=2000058. <https://doi.org/10.2807/1560-7917.ES.2020.25.4.2000058>
- [covid19.ncdc.gov.ng](https://covid19.ncdc.gov.ng)
- <https://www.premiumtimesng.com/news/headlines/...>
- Luo, S. H., Liu, W., Liu, Z. J., et al. A confirmed asymptomatic carrier of 2019 novel coronavirus (SARS-CoV-2). *Chin Med J*. 2020; 35: 100672.
- [www.thecable.ng/covid-19-most-of-those-affected...](http://www.thecable.ng/covid-19-most-of-those-affected...)
- Sun, K., Chen, J., and Viboud, C. Early epidemiological analysis of the coronavirus disease 2019 outbreak based on crowdsourced data: a population-level observational study. *Lancet Digit Hlth*. 2020;2: e201–e208
- Gebhard, C., Regitz-Zagrosek, V., Neuhauser, H. K., Morgan, R., and Klein, S. L. Impact of sex and gender on COVID-19 outcomes in Europe. *Biology of Sex Difference*. 2020; 11: 29.
- Sex, gender and Covid-19. 2020. *Global Health 5050*. <https://globalhealth5050.org/covid19/>
- Klein, S. L. Sex influences immune responses to viruses, and efficacy of prophylaxis and therapeutic treatments for viral diseases. *Bioessays*. 2012; 34 (12): 1050 – 1059. doi: 10.1002/bies.201200099
- Conti, P., and Younes, A. Coronavirus Covid-19/Sars-Cov-2 affects women less than men: clinical response to viral infection. *J Biol Regul Homeost Agents*. 2020; 34 (2): doi:10.23812/Editorial-Conti-3.
- Marriott, I., and Huet-Hudson, Y. M. Sexual dimorphism in innate immune responses to infectious organisms. *Immunol Res*. 2006; 34: 177–192.
- Boissier, J., Chlichlia, K., Dignon, Y., Ruppel, A., and Mone, H. Preliminary study on sex-related inflammatory reactions in mice infected with *Schistosoma mansoni*. *Parasitol Res*. 2003; 91: 144–150.
- Xia, H. J., Zhang, G. H., Wang, R. R., and Zheng, Y. T. The influence of age and sex on the cell counts of peripheral blood leukocyte subpopulations in Chinese rhesus macaques. *Cell Mol Immunol*. 2009; 6: 433–440.
- Melgert, B. N., Oriss, T. B., Qi, Z., et al. Macrophages: regulators of sex differences in asthma? *Am J Respir Cell Mol Biol*. 2010; 42: 595–603.
- You, H., Zhou, D., Wu, S., Hu, X., and Bie, C. Social deprivation and rural public health in China: Exploring the relationship using spatial regression. *Soc Indic Res*. 2020. 147: 843–864.
- You, H. Quantifying megacity growth in response to economic transition: A case of Shanghai, China. *Habitat Int*. 2016; 53: 115–122.

34. Chan, J.F., Yuan, S., Kok, K.H., et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: A study of a family cluster. *Lancet*. 2020; 395: 514–523.
35. Alley, C., and Sommerfeld, J. Infectious disease in times of social and ecological change. *Med Anthropol*. 2014; 33: 85–91
36. Heesterbeek, H., Anderson, R. M., Andreasen, V., et al. Modeling infectious disease dynamics in the complex landscape of global health. *Science*. 2015; 347: aaa4339.
37. Wang, L., Gao, Y., Lou, L., and Zhang, G. The clinical dynamics of 18 cases of COVID-19 outside of Wuhan, China. *Euro Respir J*. 2020; 55: 2000398. doi: 10.1183/13993003.00398-2020
38. Bai, Y., Yao, L., Wei, T., Tian, F., Dong-Yan, J., Lijuan, C., and Wang, M. Presumed Asymptomatic Carrier Transmission of COVID-19. *JAMA*. 2020; 323 (14): 1406-1407. doi:10.1001/jama.2020.2565
39. Lo, I. L., Lio, C. F., Cheong, H. H., et al. Evaluation of SARS-CoV-2 RNA shedding in clinical specimens and clinical characteristics of 10 patients with COVID-19 in Macau. *Int J Biol Sci*. 2020; 16 (10): 1698 – 1707 doi:10.7150/ijbs.45357
40. Zou, L., Ruan, F., Huang, M., et al. SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients. *N Engl J Med*. 2020; 382: 1177-1179. doi:10.1056/NEJMc2001737

ARTICLE IN PRESS