Jagua Publication

Journal of Applied Health Sciences and Medicine 3(4) (2023): 22 –30 www.jpub.org

Research Article

Study on the Association Between Malaria and Occupation Among Covid-19 Subjects

Rhoda Nwalozie[1*], Evelyn Orevaoeghene Onosakponome[2], Brenda Anyakwe Nnokam[3], Stephenson Danagogo Lawson[4]

[1]Department of Medical Laboratory Science, Rivers State University, Port Harcourt, Nigeria
[2]Department of Medical Laboratory Science, PAMO University of Medical Sciences, Port Harcourt, Nigeria
[3]Department of Family Medicine, College of Medicine, Rivers State University, Port Harcourt, Nigeria
[4]Department of Medical Microbiology and Parasitology, Rivers State University, Port Harcourt, Nigeria

How to cite:
Nwalozie et al. 2023. "Study on the Association Between Malaria and Occupation Among Covid-19 Subjects". *Journal of Applied Health Sciences and Medicine* 3(4): 22 – 30. https://doi.org/10.58614/jahsm343

Received:
March 20, 2023
Accepted:
April 9, 2023
Published:
April 13, 2023

Abstract: The COVID-19 pandemic has caused widespread illness, death, and economic disruption around the world. At the same time, malaria continues to be a leading cause of death in many countries. This study aims to examine the relationship between COVID-19, malaria, and occupation. It was a cross sectional study of 400 COVID-19 positive patients. Data were collected through questionnaires and blood samples collected and examined for malaria parasite. The data gotten was analyzed using graph pad prism Version 8.0.2.263. Results gotten reveals that risk factors are not significantly associated with occupation, Prevalence of malaria is not significantly associated with occupation, the level of Parasitaemia is not significantly associated with occupation and Symptoms are also not significantly associated with occupation at $p>0.05$. The study has confirmed that risk factors, prevalence of malaria, severity of parasitaemia and symptoms have no association with occupation. These findings highlight the need for targeted interventions to protect other populations, including measures to improve access to personal protective equipment and treatment for COVID-19 and malaria.

Keywords: malaria, plasmodium, COVID-19, occupation.

1. Introduction

Parasite of the genus *Plasmodium* causes malaria parasitic infection, this infection is transmitted by Anopheles mosquitoes, and this infection leads to an acute life-threatening disease and poses a great global health threat. World Health Organization (WHO) data of 2018 shows that about 228 million cases of malaria and 405,000 deaths were reported worldwide, with Africa recording the highest number of cases and the highest mortality (WHO, 2019).

There are four species of malaria which are: P. *falciparum*, P. *ovale*, P. m*alariae* and P. *vivax*. P. *knowlesi*, this is a fifth specie that was previously found in monkeys but has also been shown to infect humans. (Dennis *et al*., 2005). Tropical malaria is usually implicated with either P. *falciparum* or P. *vivax*, and most that causes deaths are due to P. *Falciparum (*Warrell *et al*., 1990; Ogunledun *et al*., 1991; Miguel *et al*., 2006) What is known as mixed infection causes 5-7% of infection which is caused by

Corresponding author:
Rhoda Nwalozie
rhoda.nwalozie@ust.edu.ng

more than one species of plasmodium. *(*Warrell *et al*., 1990). Malaria infection is gotten through the bite of female *Anopheles* mosquito, exposure to infected blood product can also lead to malaria (Known as transfusion malaria) and from mother to child (congenital transmission). in industrialized countries most malaria infection recorded are seen in military personnel, travellers, immigrants, or returning from areas endemic for malaria (*imported malaria*). Worthy of note is that local transmission with malaria occurs through the bite of mosquito (*indigenous malaria* which is malaria that is gotten and transmitted within a locality rather than coming or imported from somewhere else) (Onwujekwe *et al*., 2000).

In Nigeria alone 50% of all expenditures on curative diseases annually are used for malaria treatment and prevention (Onwujekwe *et al*., 2000). Malaria is considered a serious health challenge in Nigeria. Those more at risk of malaria infection include children, pregnant women and the elderlies. Every year in Nigeria over 50% of the 140 million population is faced with one case of malaria. (Ezejie *et al*., 1991). Recently malaria vectors has acquired resistance to therapies and this has made the treatment of malaria challenging, while cases of resistance by the parasites are increasing by the day. New therapies are not properly applied because of fear of lack of effectiveness. (Ezejie *et al*., 1991). Statistics show that 3-3.5 million annual deaths worldwide take place due to malaria infection (Rigler & Lake, 1993; Harshad, 2005). Statistics also showed that malaria kills one child every 30 seconds and about 3000 children daily (Anand *et al*., 1992). Children between age 5 years and below are more prevalence in these death situations. 90% of the deaths annually that occur in rural sub-Saharan Africa are attributed to malaria infestation (Miguel *et al*., 2006). According to epidemiological studies, at least 20% of all deaths in children under five in Africa are due to malaria (Mishra *et al*., 1992).

The identification of a new coronavirus In December 2019 showed that this strain of virus was responsible for many pneumonia cases in Wuhan, a city in the Hubei Province of China. The number of identified cases has then increased greatly in China, and spread all over the world causing an epidemic. The virus is now known as “severe acute respiratory syndrome coronavirus 2” (SARS-CoV-2). The occurrence of the disease was first reported to the WHO in December 31, 2019, and the COVID-19 epidemic was declared a global health emergency in January 30, 2020, then a global pandemic in March 11, 2020 (WHO, 2020).

Malaria and COVID-19 usually have similar presentation, some of these similar symptoms they share include but not limited to: tiredness and acute onset headache, fever, breathing difficulties, which can bring about misdiagnosis of malaria for COVID-19 and vice versa, especially when health care practitioners relies mainly on symptoms. COVID-19 has been shown to have an effect on some malaria combating projects such as insecticide-treated bed nets (ITNs) distribution and seasonal malaria chemoprevention (SMC). The risks faced by health workers who provide health care services during the pandemic have also affected the testing and treatment of malaria. This has caused some difficulty in decision-making as decision-makers will need to make difficult choices to ensure that COVID-19 and other urgent, ongoing public health problems including malaria endemics are brought to their minimal effects while also reducing risks to health workers and the communities. It was established at the 2018 Astana Global Conference on Primary Health Care that the community level is

an integral platform for primary health care, and it is key in the delivery of services and essential public health functions, and to the engagement and empowerment of communities in relation to their health. The community-based activities towards supporting the continuity of essential services, such as malaria prevention, diagnosis and treatment, with its distinctive capacities for health care delivery and social engagement, have a critical role to play in the response to COVID-19 and are essential to meet people's ongoing health necessities, particularly for the most vulnerable population. Prevailing delivery approaches will need to be adapted as the risk–benefit analysis for any given activity changes in the context of a pandemic.

The COVID-19 pandemic has had a profound impact on the world, causing widespread illness, death, and economic disruption. In addition to COVID-19, malaria continues to be a major public health challenge in many countries. The two diseases have several similarities, including the potential for severe outcomes, the need for prompt diagnosis and treatment, and the potential for rapid spread.

Despite these similarities, there has been limited research on the relationship between COVID-19, malaria, and occupation. This study aims to address this gap by examining the relationship between the three factors. Understanding the relationship between COVID-19, malaria, and occupation can inform the development of targeted interventions to reduce the impact of these diseases.

2. Materials And Methods

Study Design

This was a cross sectional study where the subjects were randomly selected. The study was carried out among COVID-19 positive patients within the age limit of 18 to 65 years. Four hundred (400) participants were included in this study of which fifty (50) were students, ninety five (95) civil servants, one hundred and thirty five (135) oil workers, seventy five (75) self- employed and forty five (45) unemployed .

Eligibility Criteria

Inclusion criteria

The participants in the study included those within the age range of 18-65 years who tested positive to COVID-19 and were not on any anti-malarial drug.

Exclusion Criteria

The subjects that were excluded in this study were all who did not fall within the age bracket irrespective of their health status, all malaria infected adults on anti-malaria medication prior to commencement of this study and those who do not test positive to COVID-19.

Ethical Consideration and Informed Consent

The Ethics Committee of Rivers State Ministry of Health, Port Harcourt, Nigeria approved the protocol for this study. A written informed consent was obtained from the participants before enrolling them for the study.

Subject Selection

Participants were selected using a simple random technique where participants having even numbers as their serial numbers were recruited for the study (Okafor et al., 2022). A written Informed consent was gotten from the subjects before sample collection and socio demographic data and other relevant information were also gotten through an interviewer questionnaire.

Sample Collection

Two (2) ml of blood samples were collected through the vein aseptically with disposable hypodermic syringe and blood sample dispensed into ethylene diethyl tetracetic acid (EDTA) bottle for malaria parasite test.

Laboratory Methods

Blood film preparation as described by Evelyn et al. (2022) and Rhoda et al. (2022)

Staining Thin and Thick films using Giemsa's stain

The dried thin film was fixed in methanol. This was then stained with the thick film using Giemsa's stain. 3% solution of Giemsa stain was made and the films were stained for 30 minutes. The back of each slide was blotted with cotton wool and place in the draining rack for drying. The films were examined using x100 Objective lens, (Oil immersion). The presence of malaria parasite was done using the thick blood films while the identification of the species was done using thin blood films. A slide was scored as parasite not seen when 100 per high power fields had been examined without seeing any malaria parasite.

Statistical Analysis

The data obtained from the study were analysed using the GraphPad Prism Version 8.0.2.263. The data were expressed as mean and standard deviation. Comparison of the means was done using the one-way analysis of variance (ANOVA). The Tukey comparison test was used to verify significant differences between the groups at $P<0.05$.

3. Result

Table 1 below shows the relationship between Risk Factors and occupation among study population. Those participants with travel history consisted of 4(1.33%) students, 8(2.67%) civil servants, 12(4%) Oil workers, 7(2.33%) self-employed and 4(1.33%) unemployed. Those that used nose mask consisted of 16(4%) students, 31(7.75%) civil servants, 44(11%) oil workers, 25(6.25%) self-employed and 15(3.75%) unemployed. Those that engaged in hand washing activities include 19(3.8%) students, 35(7%) civil servants, 50(10%) oil workers, 28(5.6%) self-employed, and 17(3.4%) unemployed. And those that observed social distance consisted of 11(2.75%) students, 21(5.25%) civil servants, 31(7.75%) oil workers, 17(4.25%) self-employed and 10(2.5%) unemployed.

Table 2 below shows occupation related prevalence of malaria among covid-19 patient. Out of the 400 participants involved in the study 324 (81.0%) participants were infected with malaria while the other 76(19%) were not infected with malaria. Among those infected with malaria the highest prevalence was found among oil workers 110(27.5%) out of 135 (33.8%) of oil workers examined. The unemployed had the least prevalence 35(8.75%) out of the 45(11.3) unemployed participants examined.

Table 3 below shows the relationship between the level of parasitaemia and occupation. Among all participants infected with malaria oil workers had the highest prevalence of those having low parasitaemia 559(16.98%) and moderate parasitaemia 41(12.65%) while the unemployed had the least prevalence among those with low parasitaemia 19(5.86) and moderate parasitaemia 11(3.4%). The civil servants had the highest prevalence of those with high parasitaemia 15(4.63%) while the unemployed and the students had the lowest prevalence 5(1.54%) among those with high parasitaemia.

Table 4 below shows the relationship between symptoms and occupation among study population. Out of 239 participants examined with fever, Dyspnea, cough/sneezing, headache, loss of smell, running nose and sore throat oil workers had the highest prevalence 81(20.25%), 35(8.75%), 32(8%), 71(17.75%), 78(19.5%), 77(19.25%), and 25(6.25%) of those with fever, Dyspnea, cough/sneezing, headache, loss of smell, running nose and sore throat respectively while students had the least prevalence 30(7.5) of those with fever, unemployed had the least of those with dyspnea 12(3%), cough/sneezing 10(2.5%), headache 24(6.0%), loss of smell 26(6.5%), running nose 26(6.25) and sore throat 89(2%) respectively.

Table 1. Relationship between Risk Factors and Occupation among Study Population

Risk Factors	Students	Civil Servant	Oil Workers	Self-Employed	Unemployed	Numbers Examined	df	Chi-square	p-value	Decision
Travel History										
Yes	4(1.33)	8(2.67)	12(4)	7(2.33)	4(1.33)	42 (11.7)	4	0.063	1.00	Not Sign.
No	33(11)	63(21)	89(29.67)	50(16.67)	30(10)	353 (88.3)				
Nose mask Usage										
Yes	16(4)	31(7.75)	44(11)	25(6.25)	15(3.75)	131 (32.8)	4	0.033	1.00	Not Sign.
No	34(8.5)	64(16)	91(22.75)	50(12.5)	30(7.5)	269 (67.3)				
Hand Washing										
Yes	19(3.8)	35(7)	50(10)	28(5.6)	17(3.4)	149 (29.8)	4	0.021	1.00	Not Sign.
No	44(8.8)	84(16.8)	118(23.6)	66(13.2)	39(7.8)	351 (70.2)				
Social Distance										
Yes	11(2.75)	21(5.25)	31(7.75)	17(4.25)	10(2.5)	90 (22.5)	4	0.035	1.00	Not Sign.
No	39(9.75)	74(18.5)	104(26)	58(14.5)	35(8.75)	310 (77.5)				

Table 2. Association between Occupation and Prevalence of malaria among covid-19 patients

Occupation	NU	NI	NE	df	Chi-Square	p-value	Decision
Students	11(2.75)	39(9.75)	50 (12.5)	4	0.827	0.935	Not Sign.
Civil Servant	17(4.25)	78(19.5)	95 (23.8)				
Oil Workers	25(6.25)	110(27.5)	135 (33.8)				
Self-Employed	13(3.25)	62(15.5)	75 (18.8)				
Unemployed	10(2.5)	35(8.75)	45 (11.3)				
Total	76(19)	324(81)	400				

NE – Numbers Examined, NU – Number uninfected, LP – Low Parasitaemia, MP – Moderate Parasitaemia, HP – High Parasitaemia

Table 3. Relationship between the level of parasitaemia and occupation.

Occupation	LP	MP	HP	NI	df	Chi-Square	p-value	Decision
Students	22(6.79)	12(3.7)	5(1.54)	39 (12.0)	8	3.268	0.916	Not Sign.
Civil Servant	41(12.65)	22(6.79)	15(4.63)	78 (24.1)				
Oil Workers	55(16.98)	41(12.65)	14(4.32)	110 (34.0)				
Self-Employed	32(9.88)	19(5.86)	11(3.4)	62 (19.1)				
Unemployed	19(5.86)	11(3.4)	5(1.54)	35 (10.8)				
Total	169(52.2)	105(32.4)	50(15.4)	324 (100)				

LP: Low parasitaemia, MP: Moderate parasitaemia, HP: High parasitaemia

Table 4. Relationship between Symptoms and Occupation among Study Population

Symptoms	ST	CS	OW	SE	UNE	NE	df	Chi-Square	p-value	Decision
Fever										
Yes	30(7.5)	57(14.25)	81(20.25)	44(11)	27(6.75)	239	4	0.01	1.00	Not Sign.
No	20(5)	38(9.5)	55(13.75)	30(7.5)	18(4.5)	161				
Dyspnea										
Yes	13(3.25)	25(6.25)	35(8.75)	20(5)	12(3)	105	4	0.02	1.00	Not Sign.
No	37(9.25)	70(17.5)	100(25)	55(13.75)	33(8.25)	295				
Cough/ Sneezing										
Yes	12(3)	23(5.75)	32(8)	18(4.5)	10(2.5)	95	4	0.032	1.00	Not Sign.
No	38(9.5)	73(18.25)	103(25.75)	57(14.25)	34(8.5)	305				
Headache										
Yes	26(6.5)	50(12.5)	71(17.75)	39(9.75)	24(6)	210	4	0.026	1.00	Not Sign.
No	24(6)	45(11.25)	64(16)	36(9)	21(5.25)	190				
Loss of Smell										
Yes	29(7.25)	55(13.75)	78(19.5)	44(11)	26(6.5)	232	4	0.025	1.00	Not Sign.

No	21(5.25)	40(10)	57(14.25)	32(8)	18(4.5)	168				
Running Nose										
Yes	28(7)	53(13.25)	77(19.25)	42(10.5)	25(6.25)	225	4	0.054	1.00	Not Sign.
No	22(5.5)	42(10.5)	58(14.5)	33(8.25)	20(5)	175				
Sore Throat										
Yes	9(2.25)	18(4.5)	25(6.25)	14(3.5)	8(2)	75	4	0.025	1.00	Not Sign.
No	41(10.25)	77(19.25)	110(27.5)	61(15.25)	36(9)	325				

4. Discussion

This study assessed COVID -19 and Malaria co-infection as it relates with occupation. The result from table 1 above shows the relationship between Risk Factors and occupation among study population. Those participants with travel history consisted of 4(1.33%) students, 8(2.67%) civil servants, 12(4%) oil workers, 7(2.33%) self-employed and 4(1.33%) unemployed indicating that oil workers travelled more frequently that other occupational workers in this study. This may be because of their job roles as they go from one country to another for trainings, workshops and other job -related activities. While those with least travel history from the results are the students and unemployed because they have low mobility tendency. Those that used nose mask consisted of 16(4%) students, 31(7.75%) civil servants, 44(11%) oil workers, 25(6.25%) self-employed and 15(3.75%) unemployed indicating that oil workers used nose mask more frequently than other occupations in this study while the unemployed uses it less frequently. Those that engaged in hand washing activities include 19(3.8%) students, 35(7%) civil servants, 50(10%) oil workers, 28(5.6%) self-employed, and 17(3.4%) unemployed indicating that oil workers also engaged in hand washing activities than other occupations in the study population while the unemployed engage least in hand washing. And those that observed social distance consisted of 11(2.75%) students, 21(5.25%) civil servants, 31(7.75%) oil workers, 17(4.25%) self-employed and 10(2.5%) unemployed indicating that oil workers engaged in social distance more than other populations while the unemployed engage less in social distancing. From the result from table 1 the above mentioned risk factors had no significant association with occupation at $p<0.05$, this is in agreement with the study carried out by Jani *et al*., 2019 and those of Fry *et al*., 2016.

Result from table 2 above shows occupation related prevalence of malaria among covid-19 patient. Out of the 400 participants involved in the study 324 (81.0%) participants were infected with malaria while the other 76(19%) were not infected with malaria. Among those infected with malaria the highest prevalence was found among oil workers 110(27.5%) out of 135 (33.8%) of oil workers examined this could be because oil workers are more exposed to malaria because they get more exposed to the risk factor of malaria and COVID-19. The unemployed had the least prevalence 35(8.75%) out of the 45(11.3) unemployed participants examined. This result shows that prevalence of malaria is not significantly associated with occupation at $p<0.05$. This disagrees with the study by Benjamin *et al*., 2017. In their study they observed an

association between occupation and the prevalence of malaria. This deviation could be because they used health care workers rather than other occupation in their study.

Result from table 3 above shows the relationship between the level of parasitaemia and occupation. Among all participants infected with malaria, oil workers had the highest prevalence of those having low parasitaemia 559(16.98%) and moderate parasitaemia 41(12.65%) while the unemployed had the least prevalence among those with low parasitaemia 19(5.86) and moderate parasitaemia 11(3.4%). The civil servants had the highest prevalence of those with high parasitaemia 15(4.63%) while the unemployed and the students had the lowest prevalence 5(1.54%) among those with high parasitaemia. The result indicates no significant association between the level of parasitaemia and occupation. This concurs with the study by Jani *et al*., 2019 and those of Fry *et al*., 2016.

Result from table 4 above shows the relationship between symptoms and occupation among study population. Out of 239 participants examined with fever, Dyspnea, cough/sneezing, headache, loss of smell, running nose and sore throat oil workers had the highest prevalence 81(20.25%), 35(8.75%), 32(8%), 71(17.75%), 78(19.5%), 77(19.25%), and 25(6.25%) of those with fever, Dyspnea, cough/sneezing, headache, loss of smell, running nose and sore throat respectively while students had the least prevalence 30(7.5) of those with fever, unemployed had the least of those with dyspnea 12(3%), cough/sneezing 10(2.5%), headache 24(6.0%), loss of smell 26(6.5%), running nose 26(6.25) and sore throat 89(2%) respectively. The result from table 4 above also showed that symptoms had no significant association with occupation at $p<0.05$. This agrees with study by Jani *et al*., 2019 and another study by Fry *et al*., 2016.

5. Conclusion

The findings from this study have confirmed that risk factors, prevalence of malaria, severity of malaria and symptoms of malaria has no. There is therefore need for targeted interventions to protect other populations, and to prevent malaria and COVID-19 infection in the future including measures to improve access to personal protective equipment and treatment for COVID-19 and malaria.

Reference

[1] Anand, A.C., Ramji, C., Namla, A.S. & Singh, W. (1992). Malarial hepatitis – a Heterogenous syndrome. National Medical Journal of India, 5,59-62.

[2] Benjamin, G.Y., Kanai, E. T., Moses, B. E. & Aluwong, G.S (2017) Demographic factors associated with malaria prevalence in Zaria, Kaduna state, Nigeria. Bayero Journal of Pure and Applied Sciences 10(10): 116-119.

[3] Evelyn Orevaoghene Onosakponome , Rhoda Nwalozie, Jonathan Onye buchi and Clement Ugochukwu Nyenke (2022). Prevalence of Malaria among Covid-19 patients accessing Healthcare in Selected Facilities in Rivers,Nigeria. And biological science. Merit Research Journal of Microbiology, 10(3) 27- 32

[4] Ezejie, G.C., Ezednachi, E.N., Ekaya, E.A., Gemade, E.I, Ikpatt, N.W. & Alaribe, A.A. (1991). Malaria and its treatment in rural villages of Aboh Mbaise, Imo State, Nigeria. Acta Tropica, 48, 17-24.

[5] Fry, A., Littlejohns, T.J., Sudlow, C. (2016). The representativeness of the UK Biobank cohort on a range of sociodemographic, physical, lifestyle and health- related characteristics. Journal of Epidemiology in Community Health, 70:26-31
[6] Guan, W., Ni, Z., Hu, Y., Liang, W., Ou, C. & He, J. (2020). Clinical characteristics of coronavirus disease 2019 in China. New England Journal of Medicine, 382:1708–1720.
[7] Gostic, K.M., Gomez, A.C.R., Mummah, R.O., Kucharski, A.J. & Lloyd-Smith, J.O. (2020). Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. Elife. 9:555-570.
[8] Harshad, D. (2005). Severe falciparum malaria simulating fulminant Hepatic failure. Mayo clinic proceedings: www.mayoclinicproceedings.com/inside.asp 1-2
[9] Jani, B.D., Hanlon, P. & Nicholl, B.I. (2019). Relationship between multimorbidity, demographic factors and mortality: findings from the UK Biobank cohort. British Medical Compendium, 17:74.
[10] Miguel, C., Fernandez, D., Brian, S., Bobb, E., Miguel, C. & Fernandez, O. (2006). Malaria: Specialties > Emergency Medicine > Infectious Diseases: e-Medicine.
[11] Mishra, S.K., Mohanty, S. & Das, B.S. (1992). Hepatic changes in P. falciparum malaria. Indian Journal of Malariology, 29,167-171.
[12] Okafor, R.A., Amadi, F. C.., Okolonkwo, B. N., Nyenke, C. U. and Okeke, C. U. (2022). Implication of Malaria on Liver Health. Merit Journal of Microbiology and Biological Sciences, 10(4), 40-45
[13] Onwujekwe, O.E., Chima, R. & Okonkwo, P. (2000). The economic burden of malaria illness versus that of a combination of other illness, a study in five malaria holoendemic communities. Health Policy, 54,143-159.
[14] O'Brien, D., Tobin, S., Brown, G.V. & Torresi, J. (2001). Fever in returned travelers: review of hospital admissions for a 3-year period. Clinical Infectious Disease Journal, 33:603–609.
[15] Ondoa, P., Kebede, Y., Loembe, M.M., Bhiman, J.N., Tessema, S.K. & Sow, A. (2020). COVID-19 testing in Africa: lessons learnt. Lancet Microbe, 1, 103–104.
[16] Rhoda Nwalozie , Orevaoghene Evelyn Onosakponome , Brenda Anyakwe Nnokam and Tamunonengiye-Ofori Lenox-Prince (2022) Evaluation of Malaria Parasitaemia among COVID-19 Patients in Rivers State. Nigeria. Journal of Applied Life Sciences International, 25(4), 12-18
[17] World Health Organization (2019). World malaria report . Geneva: https ://www.who.int/publi catio ns/i/item/world -malar ia-report
[18] World Health Organization (2020). declares public health emergency for novel coronavirus. https :// www.medsc ape.com/viewa rticl e/92459 6
[19] World Health Organization (2020). declares global emergency as Wuhan coronavirus spreads—The New York Times. https ://www.nytim es.com/2020/01/30/healt h/coron aviru s-world -healt h-organ izati on.html
[20] World Health Organization (2020). Coronavirus disease (COVID-19). https ://www.who.int/docs/ defau lt-sourc e/coron aviru se/situa tion-repor ts/20200 608-covid -19-sitre p-140.pdf?sfvrs n=2f310 900_2