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The Association of Initial Viral Load among COVID-19 Patients with Sociodemographic Characteristics and Travel History in Jeddah, Kingdom of Saudi Arabia, 2020

Mohammed Abdul-Aziz Kareem[1*] and Amal Hassan Al Ghamdi[2]

[1]Health Affairs for Public Health Division, Ministry of Health, Jeddah, Kingdom of Saudi Arabia.
[2]The Saudi Board Preventive Medicine Joint Program, Public Health Administration, Ministry of Health, Jeddah, Kingdom of Saudi Arabia.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Since declaration of COVID-19 as a pandemic; researchers are trying to find out the clues for determining spread and transmission of the disease. Although viral load had been used for assessing severity, progress and transmissibility of the disease, yet, little is known about all factors associated with its changes. This study aims to explore the association of initial viral load among COVID-19 patients with sociodemographic characteristics and travel history.
Subjects and Methods: Through a record based retrospective study, laboratory confirmed cases in the period from 7th March to 31st May 2020 were included in the study (n=381); The dependent variable was the recorded viral load measured in Ct count; while the dependent variables included socio-demographic characteristics of the patients and travel history. Data were analyzed using Statistical Package for Social sciences (SPSS) version 21. Student t test and ANOVA test were used and P value less <0.05 was considered as a level of significance.

**Corresponding author: E-mail: Dr.M-K@hotmail.com;*

Results: Out of all respondents (n=381), there was dominance of male cases (74.0%) over females (26.0%). The great majority (83.5%) were primarily classified as being cases, while the rest were contacts (16.5%). Most of them were symptomatic (82.9%); mainly cough (44.4%), fever (41.2%), sore throat (22.0%) and runny nose (13.1%). Fifteen percent of the respondents reported that they had travelled abroad before coming back to the Kingdom of Saudi Arabia and discovered as positive for COVID-19.The mean vial load was higher in males (26.2±5.55), older cases (26.5±5.39), Saudis (26.4±5.58) and health care workers (26.9±6.32), nevertheless, these differences are not statistically significant p>0.05.There was no statistically significant difference in the viral load between symptomatic and asymptomatic cases (26.0±5.48 vs 26.6±5.63) p>0.5. Nevertheless, viral load was significantly lower among those who had fever (25.2±5.70) and dyspnea (26.4±5.46) and those who reported that they did not travel abroad (29.1±4.97) p<0.05.

Conclusion and Recommendations: The current findings add more evidence to the assumption that it is likely that asymptomatic pre-symptomatic and symptomatic transmission is occurring and there is no difference between them in viral load whether they present as cases or contacts; therefore, the repeated assessment of viral load could be more valuable and informative for assessing progress of the COVID-19 on individual level rather than comparison between positive cases. Therefore, it is highly recommended to conduct further researches based on the changes of viral load along the course of the disease and find out the role of the demographic and clinical determinants on these changes.

Keywords: Viral load; COVID-19; sociodemographic characteristics; travel history.

1. INTRODUCTION

In December 2019 the outbreak of corona virus disease (COVID-19) began in China, to turn shortly into a pandemic affecting the whole world. The symptoms of the novel corona include fever, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting and diarrhea [1]. In February, 2021, more than 106 million cases were diagnosed worldwide, over 2 million deaths reported, with a death rate around 2% [2]. Quantitative real- time reverse transcriptase- polymerase chain reaction (qRT- PCR) assay has routinely been used for the detection of causative viruses from respiratory secretions and final pathogenic diagnostics of COVID- 19 according to the cycle threshold (Ct). Ct values were inversely related to viral RNA copy numbers with a Ct value <40 being considered positive [3]. Studying viral dynamics and their variation among population subgroups may help in understanding the role of epidemiological characteristics in the disease development and outcome. Uncertainty still exist regarding the relationship between viral load and severity, infectivity and duration of COVID-19's viral dynamics and how they relate to factors in the population [4,5]. Moreover, evidence on the association between viral load and other factors, including age and sex, nationality has not been conclusive. Some studies found that higher viral load in the respiratory system was associated with higher in-hospital mortality and morbidity [6,7]. and a higher risk of transmission; [8] while other studies found no such relationship [4]. Understanding viral load dynamics and covariates is critical for identifying protective measures for individuals and the general public. Therefore, this study investigates the association of viral load with certain sociodemographic and the outcome of COVID-19 patients.

2. MATERIALS AND METHODS

Through a record based retrospective study, all laboratory confirmed COVID-19 cases who were diagnosed at health care facilities in Jeddah governorate in the period from 7th March to 31st May 2020 were included in the study (inclusion criteria); the exclusion criteria were the cases recorded out of the study designated duration and cases confirmed outside Jeddah. The data were extracted from the database of the Health Electronic Surveillance Network (HESN) which is originally designated for registering and reporting communicable diseases in the Kingdom of Saudi Arabia. The data include demographic characteristics of each patient together with clinical and laboratory findings along progress of the case, and it is accessible for treating physicians, lab personnel and authorized personnel in charge in the health directorates over the whole country. After getting the approval for conducting the research, the researchers accessed the relevant data and retrieved it in an excel sheet. The dependent variable was the

recorded viral load measured in Ct count; while the independent variables included socio-demographic characteristics of the patients (age, gender, nationality and job), clinical findings and travel history. Data were coded and analyzed using Statistical Package for Social sciences (SPSS) version 21. Qualitative variables are summarized and presented as frequency distribution, while quantitative normally distributed variables are presented in mean and standard deviation. Student t test was used for comparing continuous outcome (viral load) in two subgroups, while ANOVA test was used to compare it within three or more groups. A confidence level of 95% (CI 95%) was adopted throughout the study, P value less than 0.05 was considered as a level of significance.

3. RESULTS

Out of all recorded cases (n=381), there was marked dominance of male cases (74.0%) over females (26.0%), with a mean age of 38.0±13.8 years, it ranged between one year and 82 years old, and the relatively older cases aged forty years or older formed 40.9% of them. There was dominance of non-Saudis (64.0%) over Saudis (36.0%); who were mostly from Bangladesh (17.8%), Yemen (8.1%), India (7.9), Pakistan (6.3%) and Philippine (6.3%). Health care workers constituted 9.4% of the cases; mainly those who are working in administrative tasks (3.9%), nurses (2.1%), lab technicians (1.3%) and physicians (1.3%) [Table 1]. The great majority (83.5%) were primarily classified as being cases, while the rest were contacts (16.5%). Most of them were symptomatic (82.9%); mainly cough (44.4%), fever (41.2%), sore throat (22.0%), runny nose (13.1%) and difficult breathing (7.6%). The average viral load was 26.1±5.4; it ranged between 9.44-37.49 [Table 2]. Fifteen percent of the respondents reported that they had been traveling abroad before coming back to Saudi Arabia and discovered as positive for COVID-19 [Fig. 1]. They were mainly coming from Switzerland (3.7%), Turkey (2.4%), Egypt (1.6%), UK (1.3%) and USA (1.3%) [Table 3]. Table 4 demonstrates there was no significant difference in viral load between gender, age, nationality and job p>0.05. Meanwhile, Table 5 shows that there was no statistically significant difference in the viral load between those who had been categorized initially as cases or contacts (26.0±5.59 vs 26.6±5.07) as well as symptomatic cases compared to asymptomatic cases (26.0±5.48 vs 26.6±5.63) p>0.5. Nevertheless, viral load was significantly lower among those who had fever (25.2±5.70) and dyspnea (26.4±5.46) and those who reported that they did not travel abroad (29.1±4.97) and p<0.05.

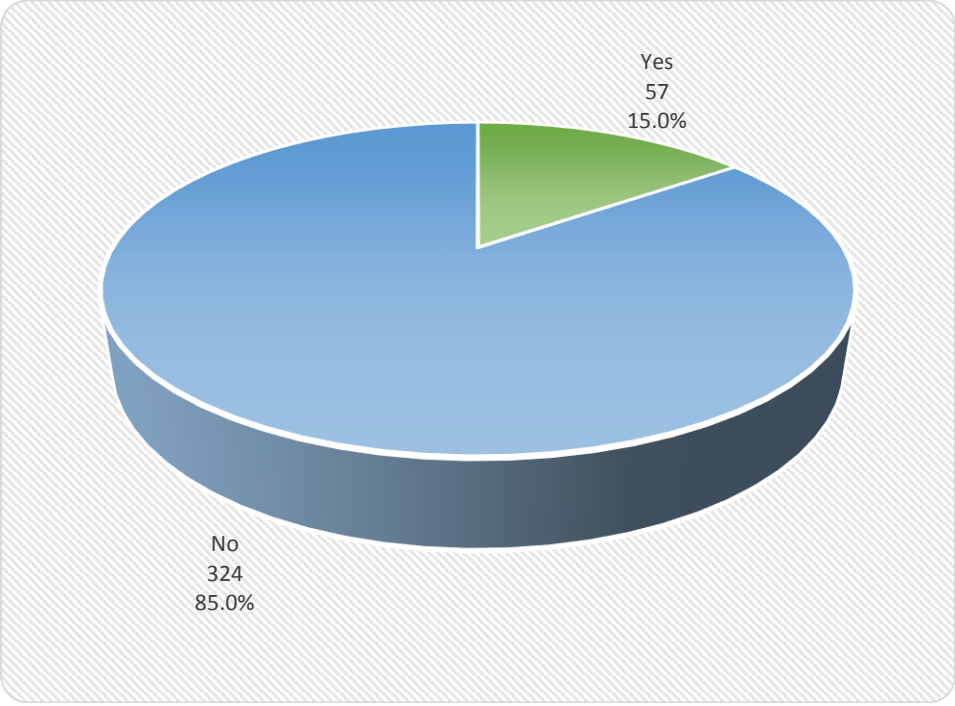

Fig. 1. History of travelling abroad before being discovered positive for Covid-19

Table 1. Socio demographic characteristics of the study group (n=381)

Characteristics	No.	Percentage
Gender:		
Male	282	74.0
Female	99	26.0
Age:		
<30 years	96	25.2
30-<40 years	129	33.9
≥40 years	156	40.9
Nationality:		
Saudi	137	36.0
Non-Saudi	244	64.0
Specific nationalities of non-Saudis:		
Bangladesh	68	17.8
Yemen	31	8.1
India	30	7.9
Pakistan	24	6.3
Philippines	24	6.3
Sudan	16	4.2
Egypt	13	3.4
Turkey	10	2.6
Others	28	7.3
Job:		
Health care worker	36	9.4
Others	345	90.6
Specific jobs of health care workers:		
Administrative	15	3.9
Nurse	8	2.1
Lab technician	5	1.3
Physician	5	1.3
Pharmacist	2	0.5
Dentist	1	0.3

Table 2. Clinical characteristics of the positive Covid-19 cases

Clinical characteristics	No.	Percentage
Classification:		
Case	318	83.5
Contact	63	16.5
Symptomatic:		
Yes	316	82.9
No	65	17.1
Symptoms:		
Fever	157	41.2
Cough	169	44.4
Sore throat	84	22.0
Dyspnea	29	7.6
Runny nose	50	13.1
Sustained respiratory distress	1	0.3
Viral load:		
Mean±SD	26.1±5.4	
Range	9.44-37.49	

Table 3. List of the abroad countries for the travelers before being discovered positive for Covid-19

List of the countries	No.	Percentage
Switzerland	14	3.7
Turkey	9	2.4
Egypt	6	1.6
United Kingdom	5	1.3
USA	5	1.3
UAE	3	0.8
Lebanon	3	0.8
Philippine	3	0.8
Austria	2	0.5
Pakistan	2	0.5
Malaysia	1	0.3
Iran	1	0.3
Morocco	1	0.3
Sudan	1	0.3
Uganda	1	0.3

Table 4. Viral load according to the socio demographic characteristics of the study group

Characteristics	Mean±SD	P*
Gender:		
Male	26.2±5.55	0.789
Female	25.99±5.38	
Age:		
<30 years	25.6±5.74	
30-<40 years	26.0±5.46	0.412
≥40 years	26.5±5.39	
Nationality:		
Saudi	26.4±5.58	0.480
Non-Saudi	26.0±5.47	
Job:		
Health care worker	26.9±6.32	0.337
Others	26.0±5.41	

4. DISCUSSION

In March 2020, the world health organization (WHO) considered the rapid and aggressive spread of COVID-19 as a pandemic [9]. By the end of June 2020, the number of cases exceeded seven million cases worldwide with about 400,000 deaths [10]. Since its early beginning and along its progress, the researchers as well as the general community were concerned with the transmissibility of the virus, as it is the cornerstone for prevention and control of the pandemic [11–13]. Basically, the transmission of COVID-19, as is the case of most of the viral respiratory infectious diseases, depends on many factors, mainly the shedding of the virus which is the expelled viral particles from the infected individuals while they talk, exhale, eat, and perform other normal daily activities [13–15]. The intimate relation between viral shedding and viral load had been discussed in numerous researches; that mostly pointed to direct correlation between viral load (number of viral particles in a given unit of body fluids) and the viral shedding (infectivity) [16–18]. In this respect Jeroen and his colleagues (2020) identified that viral loads above 7 $\log_{10}$ RNA copies/mL increases likelihood of isolating infectious SARS-CoV-2 from the respiratory tract by almost fourteen times (odds ratio [OR] of 14.7 (CI 3.57-58.1; $p < 0.001$).[16] The crucial problem in transmission of COVID-19 is that the viral load from upper respiratory tract reaches its highest level at or even before appearance of clinical symptoms and for a few days after (generally within one week), with levels slowly decreasing over the next one to three weeks [19]. The long incubation and high pre-symptomatic infectivity makes transmission between family members a potential risk, since modelling of viral shedding

Table 5. Viral load according toclinical characteristics and traveling abroad of the cases

Clinical characteristics	Mean±SD	P*
Classification:		
Case	26.0±5.59	0.463
Contact	26.6±5.07	
Symptomatic:		
Yes	26.0±5.48	0.399
No	26.6±5.63	
Fever:		
Yes	25.2±5.70	0.004**
No	26.8±5.27	
Cough:		
Yes	26.3±5.56	0.410
No	25.9±5.44	
Sore throat:		
Yes	26.5±4.76	0.424
No	26.0±5.70	
Dyspnea:		
Yes	23.0±5.04	0.001**
No	26.4±5.46	
Runny nose:		
Yes	24.9±5.34	0.086
No	26.3±5.51	
Traveled abroad:		
Yes	29.1±4.97	<0.001**
No	25.6±5.43	

***Based on Independent sample t test ** Statistically significant*

suggests that the highest viral load is at or just before symptom onset, with 44% of transmission occurring before symptoms.[15]. That could explain the non-significant difference in viral load observed in the current study between symptomatic and asymptomatic positive COVID-19 cases (26.0±5.48 vs 26.6±5.63); and those who were initially categorized as being cases and those categorized as contacts (26.0±5.59 vs 26.6±5.07) p>0.05. In this regards, Jing et al (2020) claimed that assuming a mean incubation period of 5 days, a maximum infectious period of 13 days, and no case isolation," the estimated secondary attack rate among household contacts was 12·4% (95% CI 9·8–15·4) when household contacts were defined on the basis of close relatives and 17·1% (13·3–21·8) when household contacts were defined on the basis of residential address"[10]. These notions could also explain the relatively high viral load among those who got domestic infection than those who got infected abroad, as the first are more in close contact with relatives who could be asymptomatic or pre-symptomatic. Elderly households are more susceptible to exhibit relatively high viral load as shown in the current study and supported by what had been reported by To, Kelvin Kai-Wang et al (2020) that older age was significantly correlated with higher viral load (Spearman's ρ=0·48, 95% CI 0·074–0·75; p=0·020).[20]. Also, Wang and his colleagues suggested that the easy transmission even when symptoms are mild; could explain the efficient person-to-person transmission noted in health-care settings;[21] that had been shown in the current study. The significant low viral load demonstrated in our cases who had fever or dyspnea, this difference is not conclusive per symptom, as it could partly be attributed to the fact that all symptomatic cases in Saudi Arabia receive imminent treatment per protocol as soon they are discovered to be positive for COVID-19; this explanation is supported by what had been asserted by several researches that the combined treatment of COVID-19 was associated with a tendency to lower viral loads and lower IgG titers which warrants assessment in larger trials [20,22–24]. The non- significant relation between sociodemographic characteristics and viral load could be verified if further researches are conducted based on the successive changes in viral load rather than one point estimate [25].

5. CONCLUSION AND RECOMMENDATIONS

There is no difference in viral load between symptomatic and asymptomatic COVID-19 cases, only significant differences were realized with the symptomatic cases particularly those who fever and dyspnea, that could explain the rapid progressive dissemination of the virus in the community; and lead to the conclusion that the repeated assessment of viral load could be more valuable and informative for assessing progress of the COVID-19 on individual level rather than comparison between positive cases. Therefore, it is highly recommended to include spaces for recording successive readings of viral load in HESN application to facilitate monitoring for its progress. Also, there is a need to conduct further researches based on the changes of viral load along the course of the disease and find out the role of the demographic and clinical determinants on these changes

6. LIMITATION OF THE STUDY

The main limitation of the current study comes in line with what is known about the inherited limitations in the record-based study design where the researchers are confined to the available data which are not essentially the optimal data needed for the research, this fact showed itself in the current study that only one reading of the viral load was recorded in the database, it would be more beneficial if several readings were recorded to assess the changes of the viral load along the course of each case.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Ethical approval was obtained from the regional Institutional Research Board (IRB) in Jeddah (Number: A01155).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. CDC. Symptoms of Coronavirus;2019.
2. WHO. Coronavirus Disease (COVID-19) Dashboard;2021.
3. Wang, Y., Kang, H., Liu, X., Tong Z. Combination of RT-qPCR testing and clinical features for diagnosis of COVID-19 facilitates management of SARS-CoV-2 outbreak. J Med Virol;2020.
4. Walsh KA, Jordan K, Clyne B, Rohde D, Drummond L, Byrne P, et al. SARS-CoV-2 detection, viral load and infectivity over the course of an infection. J Infect. 2020;81(3):357–71.
5. Wang Y, Zhang L, Sang L, Ye F, Ruan S, Zhong B, et al. Kinetics of viral load and antibody response in relation to COVID-19 severity. J Clin Invest. 2020;130(10):5235–44.
6. Magleby R, Westblade LF, Trzebucki A, Simon MS, Rajan M, Park J, et al. Impact of Severe Acute Respiratory Syndrome Coronavirus 2 Viral Load on Risk of Intubation and Mortality Among Hospitalized Patients With Coronavirus Disease 2019. Clin Infect Dis. 2020;ciaa851.
7. Maltezou HC, Raftopoulos V, Vorou R, Papadima K, Mellou K, Spanakis N, et al. Association Between Upper Respiratory Tract Viral Load, Comorbidities, Disease Severity, and Outcome of Patients With SARS-CoV-2 Infection. J Infect Dis. 2021;223(7):1132–8.
8. Shrestha NK, Canosa FM, Nowacki AS, Procop GW, Vogel S, Fraser TG, et al. Distribution of transmission potential during nonsevere COVID-19 illness. Clin Infect Dis. 2020;71(11):2927–32.
9. World Health Organization. World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard. World Health Organization;2020.
10. Jing Q-L, Liu M-J, Zhang Z-B, Fang L-Q, Yuan J, Zhang A-R, et al. Household secondary attack rate of COVID-19 and associated determinants in Guangzhou, China: a retrospective cohort study. Lancet Infect Dis. 2020;20(10):1141–50.
11. Widders A, Broom A, Broom J. SARS-CoV-2: The viral shedding vs infectivity

dilemma. Infect Dis Health. 2020;25 (3):210–5.
12. Corsini Campioli C, Cano Cevallos E, Assi M, Patel R, Binnicker MJ, O'Horo JC. Clinical predictors and timing of cessation of viral RNA shedding in patients with COVID-19. J Clin Virol. 2020;130: 104577.
13. He X, Lau EHY, Wu P, Deng X, Wang J, Hao X, et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. Nat Med. 2020;26(5):672–5.
14. Cheng PK, Wong DA, Tong LK, Ip S-M, Lo AC, Lau C-S, et al. Viral shedding patterns of coronavirus in patients with probable severe acute respiratory syndrome. The Lancet. 2004;363(9422):1699–700.
15. Little P, Read RC, Amlôt R, Chadborn T, Rice C, Bostock J, et al. Reducing risks from coronavirus transmission in the home—the role of viral load. BMJ. 2020;369:m1728.
16. van Kampen JJA, van de Vijver DAMC, Fraaij PLA, Haagmans BL, Lamers MM, Okba N, et al. Duration and key determinants of infectious virus shedding in hospitalized patients with coronavirus disease-2019 (COVID-19). Nat Commun. 2021;12(1):267.
17. Li C-C, Wang L, Eng H-L, You H-L, Chang L-S, Tang K-S, et al. Correlation of Pandemic (H1N1) 2009 Viral Load with Disease Severity and Prolonged Viral Shedding in Children. Emerg Infect Dis. 2010;16(8):1265–72.
18. La Scola B, Le Bideau M, Andreani J, Hoang VT, Grimaldier C, Colson P, et al. Viral RNA load as determined by cell culture as a management tool for discharge of SARS-CoV-2 patients from infectious disease wards. Eur J Clin Microbiol Infect Dis. 2020;39(6):1059–61.
19. Huang J, Mao T, Li S, Wu L, Xu X, Li H, et al. Long period dynamics of viral load and antibodies for SARS-CoV-2 infection: an observational cohort study. Infectious Diseases (except HIV/AIDS); 2020.
20. To KK-W, Tsang OT-Y, Leung W-S, Tam AR, Wu T-C, Lung DC, et al. Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: an observational cohort study. Lancet Infect Dis. 2020;20(5):565–74.
21. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China. JAMA. 2020;323(11):1061–9.
22. Gottlieb RL, Nirula A, Chen P, Boscia J, Heller B, Morris J, et al. Effect of Bamlanivimab as Monotherapy or in Combination With Etesevimab on Viral Load in Patients With Mild to Moderate COVID-19: A Randomized Clinical Trial. JAMA. 2021;325(7):632–44.
23. Chaccour C, Casellas A, Matteo AB-D, Pineda I, Fernandez-Montero A, Castillo PR, et al. The effect of early treatment with ivermectin on viral load, symptoms and humoral response in patients with mild COVID-19: a pilot, double-blind, placebo-controlled, randomized clinical trial [Internet]. In Review; 2020 Dec [cited 2021 Sep 3]. Available:https://www.researchsquare.com /article/rs-116547/v1
24. Goldberg E, Ben Zvi H, Sheena L, Sofer S, Krause I, Sklan EH, et al. A real-life setting evaluation of the effect of remdesivir on viral load in COVID-19 patients admitted to a large tertiary centre in Israel. Clin Microbiol Infect. 2021;27(6):917.e1-917.e4.
25. Le TQM, Takemura T, Moi ML, Nabeshima T, Nguyen LKH, Hoang VMP, et al. Severe Acute Respiratory Syndrome Coronavirus 2 Shedding by Travelers, Vietnam, 2020. Emerg Infect Dis. 2020;26(7):1624–6.

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