World Journal of Public Health
2023; 8(4): 310-314
http://www.sciencepublishinggroup.com/j/wjph
doi: 10.11648/j.wjph.20230804.19
ISSN: 2637-6040 (Print); ISSN: 2637-6059 (Online)

Prevalence and Determinants of COVID-19 Reinfection: A Cross-Sectional Study Among Residents in a County in the United States

Emmanuel Opada[1, *], David Gonzales[1], Delilah Perez[1], Shannon Giestman[1], Nsikan Affiah[2]

[1]Victoria County Public Health Department, Victoria, USA

[2]Creative Associate International, Abuja, Nigeria

Email address:

Emmanuelopada86@gmail.com (Emmanuel Opada)

[*]Corresponding author

To cite this article:

Emmanuel Opada, David Gonzales, Delilah Perez, Shannon Giestman, Nsikan Affiah. (2023). Prevalence and Determinants of COVID-19 Reinfection: A Cross-Sectional Study Among Residents in a County in the United States. *World Journal of Public Health*, *8*(4), 310-314. https://doi.org/10.11648/j.wjph.20230804.19

Received: November 10, 2023; **Accepted**: November 30, 2023; **Published**: December 18, 2023

Abstract: As the spread of COVID-19 infection seems to be unending, several investigations have examined the occurrence of COVID-19 reinfection particularly among healthcare professionals potentially due to the inherent exposure risks in their line of work. Furthermore, considering the increase in the emergence of different variants, it is also quite revealing that significant number of the population is still unvaccinated. Thus, the purpose of this study was to ascertain the prevalence of COVID-19 reinfection among individuals residing in a County as well as to determine the factors that contribute to reinfection. This study focuses on the County of Victoria, located in the Southeastern Texas, on the Coastal Plain about midway between the southern and eastern extremities of the Texas Gulf Coast. Using a cross sectional study design and where data from 20,499 COVID-19 cases reported to the health department between March 2020 and December 2022 together with their corresponding vaccination status on ImmTrac2 during the reporting period and the corresponding cases of reinfection were analyzed. Variables included in the dataset were age, sex, date of onset of illness, date of sample collection, date diagnosis was made, date of death (if applicable), vaccination status, date of previous infection, previous ID number & name of health facility. Percentages, frequencies, Chi-square and multivariate logistic regression was employed with a significance level of $p < 0.05$ predicting reinfection on a number of indicators using SPSS version 28 statistical software. The findings revealed that the odds for reinfection among vaccinated individuals was 0.289 (95% confidence interval 0.244-0.342). Also, the odds ratio (OR) for reinfection among Hispanics was 1.507 (95% confidence interval 1.275-1.782) compared to non-Hispanics. Lastly, the odds ratio (OR) for reinfection among males was 0.873 (95% confidence interval 0.747-1.021). Additionally, out of the 20,499 reported cases of COVID-19, there were 932 reinfections, accounting for 4.5% of the total cases. One of the main findings of the study was that vaccination against COVID-19 offered about 70% protection against reinfection compared to the non-vaccinated. In light of the emergence of new strains, it is crucial for the government and public health authorities to reassess policies regarding the enforcement of COVID-19 vaccines and prioritize improving vaccination coverage. These measures are necessary to safeguard against reinfection and mitigate the impact of COVID-19.

Keywords: Prevalence, COVID-19, Reinfection Rate, Vaccination, Determinants

1. Introduction

The novel coronavirus causes a highly infectious respiratory tract infection following its discovery in Wuhan, China in 2019 [1-3]. Within a few months of discovery, it was said to have spread around the globe causing high morbidity and mortality leading to over 753 million confirmed cases and over 6 million deaths. In the United States, since the first confirmed case on January 20, 2020, there has been over 96 million confirmed cases and over 1 million deaths as of January 16, 2023 as stated by the World Health Organization (2023). In Victoria, Texas, there were over 22,594 confirmed

cases of COVID-19 and 424 deaths within the same period. (Centers for Disease Control and Prevention, (2023). Symptoms from the infection vary from mild to severe, and most of the commonly reported symptoms include fever, cough, nausea, vomiting, diarrhea and loss of taste or smell [4, 15]. Additionally, since the early pandemic, the dominating variant, D614G was said to be more transmissible but less severe compared to the ancestral strains [9], even though several other strains of coronavirus had emerged with varying degree of virulence and transmissibility [5-8]. COVID-19 was initially thought to have a low reinfection rate, but there are concerns that the reinfection rate will increase with the emergence and spread of mutant variants. One study described a case of a 36-year-old, non-immunosuppressed man who was infected twice by two different variants of COVID-19 within a relatively short period [12]. However, the emergence of various coronavirus strains coupled with the rising number of reinfection cases calls for concerns. A number of studies have looked into reinfection of COVID-19 among healthcare workers, however, a study [10] pointed out that reinfection may primarily be due to the increased risk of exposure and possibly lack of protective equipment for healthcare workers. Another study [9] stated that the prevalence of reinfection among healthcare workers was about 2.5%. In a similar approach, a different study [11] described the prevalence of reinfection among healthcare workers (HCW). Findings from the study were not significant. Additionally, further analysis of data related to case report and cumulative cases of COVID-19 cases concluded that cases reported included reinfection within 90 days might be due to protracted primary infection. [4]. Furthermore, even though healthcare workers might be at higher risk of reinfection compared to the general population, considering the increase in the emerging variants of concern, it is worrisome to note that significant number of the population are still un-vaccinated. Thus, the study focuses on the County of Victoria located in the Southeastern Texas on the coastal plain about midway between the southern and eastern extremities of the Texas Gulf Coast [13, 14]. The County has an estimated population of 90,964 and is made up of Hispanic white, non-Hispanic white and non-Hispanic black with the population distribution of 49.1%, 42.5% and 5.7% respectively [14]. It might be beneficial to study trends of reinfection in the general population like Victoria. More so, no previous study had been identified in determining the prevalence of COVID-19 reinfection in the general population especially in a rural county level. Thus, the aim of this analysis is to determine the prevalence and determinants of COVID-19 reinfection in a community.

2. Method

2.1. Study Design

This study utilized a cross-sectional study design.

2.2. Study Population

Data were obtained from the Victoria County Health Department COVID-19 surveillance dashboard and ImmTrac2, Texas immunization registry. The study population included 20,499 COVID-19 cases reported from all hospitals and nursing homes in Victoria County, Texas from March 20, 2020 through December 31, 2022. Variables included in the dataset were age, sex, date of onset of illness, date sample was collected, date diagnosis was made, date of death (if applicable), vaccination status, date of previous infection, previous ID number, name of health facility.

Inclusion criteria: Positive SAR-COV 2 (PCR COVID-19 case report and positive antibody testing) were considered cases of reinfection ≥ 90days of the initial infection.

2.3. Data Analysis

Data were analyzed using SPSS version 28. Descriptive statistics showing simple percentages was used to describe prevalence of reinfection. Binary logistic regression was adopted to determine factors influencing COVID-19 reinfection. Variables predicted include being vaccinated, Hispanic, race, sex, and age group. To verify model improvement, a backward elimination approach was carried out for the logistic regression. Variables eliminated were date of onset of illness, date sample was collected, date diagnosis was made, date of death (if applicable), date of previous infection, previous ID number, and name of health facility. Data were subsequently cleaned to eliminate reinfection within 90 days of previous infection. Likewise, categorical variables such as race, sex, and age were also cleaned and reclassified. Reinfection was predicted using some categorical variables such as vaccination status, race, sex, and age. Pearson chi- square was applied on some independent variables and having reinfection status as dependent variable. Test statistics were two-sided and P value of 0.05 was considered significant.

2.4. Ethical Approval

Although the study considered data analysis, rather than research on human subject, there was organization/ ethical review board approval.

3. Results

The result reflects the information obtained from 20,499 clients whose Positive COVID-19 laboratory results were presented to the Victoria Public Health Department between March 20, 2020 and December 31, 2022. Table 1 shows a demographic distribution of the study sample. About 55% of the study population were female while 45% were male. Hispanic made up 56% of the population while non-Hispanic accounted for 44%. With respect to race, 78% of the study population were white. The highest age group representation was between 25-34 years while the least age group represented was between 0-4 years.

Out the 20,499 cases of COVID-19 reported, 932 (4.5%) reinfections cases were identified. (Table 2). With respect to cases of reinfection, 670 (71.9%) of cases were of white race,

566 (60.7%) of cases were female and 366 (39.3%) were male. Also, 349 (37.4%) of cases have been vaccinated, whereas 583 (62.6%) of cases had not been vaccinated. For non-reinfection cases, 15,243 (77.9%) of cases were of white race, 10,725 (54.8%) of cases were female and 8842 (45.2%) were male. Also, 3094 (15.8%) of cases have been vaccinated, whereas 16,473 (84.2%) of cases had not been vaccinated. Figure 1 showed the distribution of confirmed cases of COVID-19 with respect to the vaccination status.3443 (17%) of the cases diagnosed were said to have been vaccinated, whereas 17,056 (83%) of the cases had no record of vaccination or had not been vaccinated.

Findings from the study showed that the odd (OR) of reinfection occurring in the vaccinated was 0.289 (95% confidence interval 0.244 -0.342). Additionally, the odd (OR) of reinfection occurring in the Hispanic was 1.507 (95% confidence interval 1.275-1.782) compared to the non-Hispanic and lastly, the odd (OR) of reinfection occurring in male was 0.873 (95% confidence interval 0.747-1.021) (Table 4).

Table 1. *Socio-demographic characteristics of confirmed cases (N=20499).*

Characteristics	Study population (20499)	Percentages
Categorical Variables	**n**	**n (%)**
Race		
Asian (1)	41	.2
Black (2)	902	4.4
White (3)	15907	77.6
Other (4)	3649	17.8
Sex		
Male	9204	44.9
Female	11295	55.1
Hispanic		
Yes	11438	55.8
No	9061	44.2
Age group		
0-4 (1)	738	3.6
5-11 (2)	984	4.8
12-17 (3)	1312	6.4
18-24 (4)	2193	10.7
25-34 (5)	3239	15.8
35-44 (6)	3136	15.3
45-54 (7)	2870	14.0
55-64 (8)	2624	12.8
>65	3403	16.6

Table 2. *Percentages of reinfection cases.*

Reinfection Status	Study population (20499)	Percentages (n %)
Yes	932	4.5
No	19567	95.5

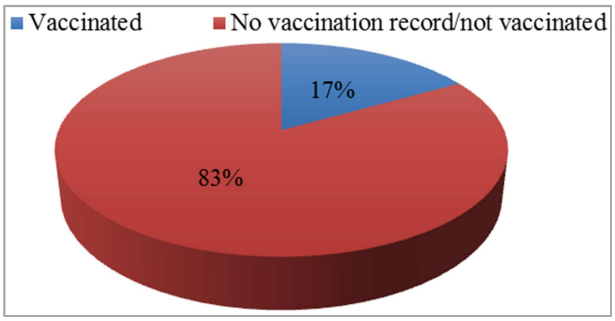

Figure 1. *Vaccination status.*

Table 3. *Case distribution by reinfection status.*

Variables	Reinfection (n=932)	Non-reinfection (n=19567)	p-value
Asian	0 (0)	40 (0.0)	
Black	32 (3.4)	862 (4.4)	<0.001
White	670 (71.9)	15243 (77.9)	
Others	230 (24.7)	3422 (17.5)	
Sex			
Male	366 (39.3)	8842 (45.2)	<0.001
Female	566 (60.7)	1072 (54.8)	
Vaccination			
Yes	349 (37.4)	3094 (15.8)	<0.001
No	583 (62.6)	16473 (84.2)	
Age			
0-4	12 (1.3)	684 (3.5)	
5-11	37 (4.0)	944 (4.8)	
12-17	36 (3.9)	1258 (6.4)	
18-24	74 (7.9)	2098 (10.7)	
25-34	161 (17.3)	3094 (15.8)	<0.001
35-44	159 (17.1)	2987 (15.3)	
45-54	171 (18.3)	2737 (14.0)	
55-64	140 (15.0)	2506 (12.8)	
≥65	142 (15.2)	3259 (16.7)	

Table 4. *Binary Logistic Regression on Reinfection status.*

Variables	Odd Ratio.	St Err	p-value	95% Conf	Interval]
Vaccinated	0.289	0.086	<0.001	0.244	0.342
Hispanic	1.507	0.086	<0.001	1.275	1.782
Sex	0.873	0.080	0.089	0.747	1.021

*** p<.01, ** p<.05, * p<.1

4. Discussion

This study contributes to the limited body of research on the rate of COVID-19 reinfection. Previous studies on reinfection primarily focused on healthcare workers due to their elevated risk of exposure in comparison to the general population. However, this study examines reinfection rates in the general population, who may not experience comparable exposure conditions. Furthermore, the prevalence of COVID-19 reinfection among healthcare workers, as reported in study [9], was found to be 2.5%, which was about half of the reinfection prevalence (4.5%) observed in this current study. Although, considering various preventive measures advocated and implemented by government and public health such as the availability of vaccine and even the extension of vaccine to include children below 5years, COVID-19 reinfection appears to be on the increase. Furthermore, only about 17% of the cases of COVID-19 identified in the course of this study received at least one form of vaccine. Even though it appeared that there were still a very high cases of eligible individuals yet to be vaccinated, it was also possible that many of these individuals identified might have been subsequently vaccinated following the reporting of their COVID-19 cases to the Health Department and/or have not developed reinfection which would require their vaccination status to be rechecked. Additionally, with the position of government on policies, which tend to relax COVID-19 vaccine mandate, for instance,

in the state of Texas, this could possibly contribute to vaccine hesitancy. Consequently, there would be the need to understand other possible factors responsible for the significant increase in the un-vaccination rate, including behavioral factors to be able to implement evidence-based intervention that would really address such factors. Consequently, with the emergence of various strains of COVID-19 and the varying degree of virulence or transmissibility [12], there is an increasing concern for reinfection not only for healthcare workers, but also for the general population at large. Thus, looking at the possible risk factors for reinfection, the odd of reinfection among the vaccinated was 70% lowered compared to the unvaccinated individuals. In addition, among Hispanic, the odd of reinfection was about 1.5 times versus the non-Hispanic. Another explanation for this increase in odd of reinfection among Hispanic might be directly related to the Hispanic population making up more than half of the study population. Finally, being a male could have about 13% lower rate of reinfection compared female which might also explains why a slightly significant number of the cases were females.

5. Conclusion

In conclusion, the occurrence of COVID-19 reinfection is on the rise, affecting not only healthcare workers but also the general population. Given the emergence of new variants, it is imperative for governments and public health authorities to implement comprehensive measures. These measures should include enhancing vaccination coverage to mitigate the risk of COVID-19 reinfection. Additionally, further studies are necessary to investigate the determinants, including behavioral factors that contribute to the noncompliance of eligible individuals with vaccination protocols. By understanding these factors, appropriate strategies can be implemented to promote vaccination acceptance and adherence among the population.

6. Recommendation

There is a pressing need not only to enhance vaccination efforts but also to gain a comprehensive understanding of the influential factors that affect vaccination rates. In addition, it is crucial for governments to reevaluate existing policies that hinder the enforcement of COVID-19 vaccination across all government and non-governmental organizations. By promoting the adoption of COVID-19 vaccines in these settings, vaccine advocacy can be strengthened through enhanced collaboration between the public and private sectors. Furthermore, we highly recommend fostering collaboration between public health entities and the media to launch impactful behavioral change campaigns. These campaigns can play a vital role in encouraging individuals to accept vaccination as a responsible and necessary measure for public health. It is essential to conduct research aimed at understanding human behavior, delving into the reasons behind people's actions and decisions. This research will provide valuable insights that can inform the development of effective solutions to address vaccine hesitancy and promote vaccine acceptance. By addressing these elements comprehensively, we can work towards increasing vaccination rates and achieving higher levels of public health protection in the face of pandemic or epidemics.

Disclaimer

The findings and conclusions presented here are those of the authors and do not necessarily represent the official position of the CDC or DSHS.

Acknowledgments

We appreciate the authority of the County of Victoria and the executives of the Victoria County Public Health department for the approval and support provided to make this research possible.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Bergquist S, Otten T, Sarich N. (2020) COVID-19 pandemic in the United States. Health Policy Technol. 2020 Dec; 9(4): 623-638. doi: 10.1016/j.hlpt.2020.08.007. Epub 2020 Aug 27. PMID: 32874854; PMCID: PMC7451131.

[2] Cucinotta D, Vanelli M. (2020) WHO Declares COVID-19 a Pandemic. Acta Biomed. 2020 Mar 19; 91(1): 157-160. doi: 10.23750/abm.v91i1.9397. PMID: 32191675; PMCID: PMC7569573.

[3] Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, Iosifidis C, Agha R. (2020) World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). Int J Surg. 2020 Apr; 76: 71-76. doi: 10.1016/j.ijsu.2020.02.034. Epub 2020 Feb 26. Erratum in: Int J Surg. 2020 May; 77: 217. PMID: 32112977; PMCID: PMC7105032.

[4] Habas K, Nganwuchu C, Shahzad F, Gopalan R, Haque M, Rahman S, Majumder AA, Nasim T. (2020) Resolution of coronavirus disease 2019 (COVID-19). Expert Rev Anti Infect Ther. 2020 Dec; 18(12): 1201-1211. doi: 10.1080/14787210.2020.1797487. Epub 2020 Aug 4. PMID: 32749914.

[5] Bhattacharya S, Basu P, Poddar S (2020). Changing epidemiology of SARS-CoV in the context of COVID-19 pandemic. J Prev Med Hyg. 2020 Jul 4; 61(2): E130-E136. doi: 10.15167/2421-4248/jpmh2020.61.2.1541. PMID: 32802995; PMCID: PMC7419125.

[6] Sharma R, Sardar S, Mohammad Arshad A, Ata F, Zara S, Munir W (2020) A Patient with Asymptomatic SARS-CoV-2 Infection Who Presented 86 Days Later with COVID-19 Pneumonia Possibly Due to Reinfection with SARS-CoV-2. Am J Case Rep. 2020 Dec 1; 21: e927154. doi: 10.12659/AJCR.927154. PMID: 33257644; PMCID: PMC7718490.

[7] Shaheen NA, Sambas R, Alenezi M, Alharbi NK, Aldibasi O, Bosaeed M. (2022). COVID-19 reinfection: A multicenter retrospective study in Saudi Arabia. Ann Thorac Med. 2022 Apr-Jun; 17(2): 81-86. doi: 10.4103/atm.atm_74_22. Epub 2022 Apr 19. PMID: 35651891; PMCID: PMC9150659.

[8] Aleem A, Akbar Samad AB, Slenker AK. (2022). Emerging Variants of SARS-CoV-2 And Novel Therapeutics Against Coronavirus (COVID-19). Oct 10. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan–. PMID: 34033342.

[9] Akinbami LJ, Biggerstaff BJ, Chan PA, McGibbon E, Pathela P, Petersen LR. (2022). Reinfection With Severe Acute Respiratory Syndrome Coronavirus 2 Among Previously Infected Healthcare Personnel and First Responders. Clin Infect Dis. Aug 24; 75 (1): e201-e207. doi: 10.1093/cid/ciab952. PMID: 34791108; PMCID: PMC8767877.

[10] Wei, Jia-Te, Zhi-Dong Liu, Zheng-Wei Fan, Lin Zhao, Wu-Chun Cao (2020). "Epidemiology of and Risk Factors for COVID-19 Infection among. Health Care Workers: A Multi-Centre Comparative Study" International Journal of Environmental Research and Public Health 17, no. 19: 7149. https://doi.org/10.3390/ijerph17197149

[11] Nitin P, Nandhakumar R, Vidhya B, Rajesh S, Sakunthala A. (2021) COVID-19: Invasion, pathogenesis, and possible cure - A review. J Virol Methods. 2022 Feb; 300: 114434. doi: 10.1016/j.jviromet.2021.114434. Epub 2021 Dec 14. PMID: 34919978; PMCID: PMC8669942.

[12] Shimada, N., Shinoda, M., Takei, H. *et al. (2023).* A case of reinfection with a different variant of SARS-CoV-2: case report. *Egypt J Intern Med* 35, 13 (2023). https://doi.org/10.1186/s43162-023-00194-4

[13] Craig H. Roell, (2023) "Victoria County," Handbook of Texas Online, accessed February 18, 2023, https://www.tshaonline.org/handbook/entries/victoria-county.

[14] U.S. Census Bureau, (2023) Resident Population in Victoria County, TX [TXVICT0POP], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/TXVICT0POP, February 18, 2023.

[15] Sifuentes-Rodríguez E, Palacios-Reyes D. (2020) COVID-19: The outbreak caused by a new coronavirus. Bol Med Hosp Infant Mex. 2020; 77(2): 47-53. English. doi: 10.24875/BMHIM.20000039. PMID: 32226003.