Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

American Journal of Emergency Medicine 53 (2022) 286.e5–286.e7

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Equal incidence of COVID-19 among homeless and non-homeless ED patients when controlling for confounders

Matthew Keller, MD [a,*], Jacob Shreffler, PhD [a], Kathleen Wilmes [b], Andrew Polites [b], Martin Huecker, MD [a]

[a] Department of Emergency Medicine, University of Louisville (UofL), United States of America
[b] Undergraduate Medical Education, UofL, United States of America

ARTICLE INFO

Article history:
Received 27 August 2021
Received in revised form 20 September 2021
Accepted 22 September 2021

Keywords:
Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)
Coronavirus
Pandemic
Homeless
Emergency department

ABSTRACT

Introduction: The World Health Organization (WHO) declared severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) a pandemic in March 2020. Theoretically, homeless patients could have disproportionately worse outcomes from COVID-19, but little research has corroborated this claim. This study aimed to examine the demographics and incidence of COVID-19 in homeless vs non-homeless emergency department (ED) patients.
Methods: This is a retrospective study of all patients seen in the University of Louisville Hospital Emergency Department (ULH ED) from March 2019 to December 2020, excluding January and February 2020. Data was collected from the Kentucky Homeless Management Information System (HMIS) and ULH electronic health records.
Results: A total of 51,532 unique patients had 87,869 visits during the study period. There was a 18.1% decrease in homeless patient visits over the time period, which was similar to the decrease in non-homeless patient visits (19.2%). In the total population, 9471 individuals had known COVID-19 testing results, with a total of 610 positive (6.4% positivity rate). Of the 712 homeless ED patients, 39 tested positive (5.5% positivity rate). After adjusting for age, gender identity, race, and insurance, there was no statistically significant difference in test positivity between homeless and non-homeless patients, OR 1.23 (0.88, 1.73). Homeless patients were less likely to be admitted to either the intensive care unit (ICU) or hospital (OR = 0.55, 95% CI: OR 0.51, 0.60) as they were more likely to be discharged (OR = 1.65, 95% CI: 1.52, 1.79).
Conclusion: Previous literature has indicated that higher disease burden, lack of access to social distancing, and poor hygiene would increase the risk of homeless individuals contracting COVID-19 and experiencing serious morbidity. However, this study found that homelessness was not an independent risk factor for COVID-19 infection.

1. Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) causes COVID-19, a pandemic as of March 11th 2020, according to the World Health Organization (WHO). The pandemic has resulted in unprecedented changes within healthcare systems and governments. Officials learn more each day about the virus, investigating adequate treatment methods, advising hospital responses, and contemplating the effectiveness of physical distancing along with other government mandated guidelines. COVID-19 appears to cause more severe disease in older adults and people with comorbidities such as diabetes, hypertension, and cardiopulmonary disease [1].

An estimated 553,700 Americans experience homelessness on any given night [2]. Homeless patients have higher rates of substance use and mental illness compared to non-homeless patients [3,4]. Furthermore, homeless patients have a higher chronic disease burden resulting in significant medical morbidity and risk of premature mortality [5].

It has been speculated that COVID-19 will disproportionately affect vulnerable populations such as the homeless due to their unique challenges [6,7]. Homeless individuals often lack access to care potentially live in unsanitary or crowded places. These challenges make it difficult for homeless individuals to comply with recommendations for social distancing, frequent hygiene, and self-quarantine. At the time of our study completion, most published studies have been small or speculative in regards to the effect of COVID-19 on the homeless population.

The emergency department (ED) is in a unique position to evaluate the effect of COVID-19 on the homeless by serving as a medical and social safety net, resulting in disproportionate use by homeless individuals [8]. This study aims to use data from the ED and a citywide homeless

* Corresponding author at: Department of Emergency Medicine, University of Louisville School of Medicine, 550 South Jackson, Louisville, KY 40202, United States of America.
E-mail address: matthew.keller.1@louisville.edu (M. Keller).

https://doi.org/10.1016/j.ajem.2021.09.057
0735-6757/

database to identify whether COVID-19 affects homeless individuals who present to the ED more than the general public, hypothesizing a higher incidence of COVID-19 among homeless patients.

2. Methods

This was a retrospective study of homeless patients in the University of Louisville Health system from March 2019 to December 2020, excluding January and February 2020; these two months were excluded so we could make a balanced comparison between the two years to understand the impact of COVID-19 on (homeless) patient volumes. This study included any patient seen in the University of Louisville ED identified as homeless and excluded patients under 18 years of age were excluded. To identify homeless patients, abstractors reviewed patient visits to the ED during the selected months for any patient who listed their current address as a local shelter/half-way house or other form of unstable housing. If the patient's address was listed as homeless, no physical address, homeless shelter, no known address, or the address of a homeless shelter, they were deemed homeless. Patients with address left blank or an email address were excluded.

Data from all homeless services provided in Louisville, Kentucky are tracked through a state-wide information system called Kentucky Homeless Management Information System (HMIS). Individuals in the HMIS database fit within the definition of a "homeless individual" created by the U.S. Department of Health and Human Services: *An individual who lacks housing … [or] a stable housing situation to which they can return.* Thus, all individuals listed in the HMIS were considered homeless. We cross-referenced the list of HMIS individuals with a complete list of patients seen in the ED.

During the study period, ULH ED used antigen and PCR testing for COVID-19. All patients with negative antigen tests had a reflex to PCR. Positive antigen and polymerase chain reaction (PCR) tests were considered positive for COVID-19. Negative PCR was considered a negative COVID-19 test. Duplicate charts and test results were removed by patient name, date of birth, and medical record number.

We first compared unique patient visits within the homeless population and non-homeless population. We made comparisons for admissions data utilizing chi-square tests and an independent samples *t*-test for age. We calculated and present odds ratios with 95% Cis for chi-square findings. Next, we calculated percentage change in total visits between groups. Finally, we analyzed COVID-19 testing and positivity rates between groups; for this, we present an adjusted odds ratio after controlling for race, age, gender identity, and insurance status. IBM SPSS Statistics Version 27 was utilized for analyses.

3. Results

The total number of unique ULH ED patients from March 2019 to Dec 2020, excluding January and February 2020 was 51,532. The total number of homeless patients to the ULH ED from March 2019 to Dec 2020, excluding January and February 2020 was 3911 (7.6% of ED patients). Table 1 provides demographics of homeless versus non-homeless patients during the study period.

3.1. Cohort Comparison

Homeless patients had higher rates of being male (OR = 1.67, 95% CI: 1.56–1.79) and uninsured (OR = 1.59, 95% CI: 1.48, 1.71). Homeless patients had a lower mean age compared to non-homeless patients; the mean age difference was 1.76 (95% CI: 1.17, 2.35). Furthermore, homeless patients were less likely to be admitted to either the ICU or hospital (OR = 0.55, 95% CI: OR 0.51, 0.60) as they were more likely to be discharged (OR = 1.65, 95% CI: 1.52, 1.79).

Table 1
Demographics.

	Homeless	Not Homeless
	N = 3911	*N* = 47,621
Sex, N (%)		
Female	1306 (33.4)	21,715 (45.6)
Male	2605 (66.6)	25,906 (54.4)
Race N (%)		
American Indian or Alaska Native	4 (0.1)	85 (0.2)
Asian	15 (0.4)	388 (0.8)
Black or African American	1293 (33.1)	16,985 (35.7)
More than one race	16 (0.5)	175 (0.4)
Native Hawaiian or Pacific Islander	4 (0.1)	59 (0.1)
White	2454 (62.7)	29,571(62.1)
Other or Unknown	125 (3.2)	358 (0.8)
Age		
Mean [SD]	43.6 [16.4]	45.3 [18.3]
Insurance		
Yes	2793 (71.4)	37,973 (79.7)
No	1112 (28.4)	9518 (20)
Unknown	6 (0.2)	130 (0.3)
Disposition		
Admit Floor	484 (12.4)	9672 (20.3)
Admit ICU	186 (4.8)	3322 (7)
Discharge	3111 (79.5)	33,420 (70.2)
Expired	17 (0.4)	166 (0.3)
Other	113 (2.9)	1041 (2.2)

3.2. COVID-19

A total of 51,532 unique patients had 87,869 visits during the study period. There was a decrease in homeless patient visits over the time period of 18.1%, which was similar to the decrease in non-homeless patient visits (19.2%).

Analysis found that in our sample, 9471 individuals had known COVID-19 testing results. In the ULH ED, 610 were positive (6.4% positivity rate). Of the 712 homeless individuals tested for COVID-19, 39 were positive (5.5% positivity rate). After adjusting for age, gender identity, race, and insurance there was not a statistically significant difference between homeless status and positive COVID tests, OR: 1.23 (0.88, 1.73).

4. Discussion

This study aimed to identify whether COVID-19 affects homeless individuals disproportionately compared to the general public. All previous literature indicates that the higher disease burden, lack of access to social distancing, and poor hygiene would increase the risk of homeless individuals contracting COVID-19 and experiencing serious morbidity. While the rate of COVID-19 positive testing in homeless patients was higher than nonhomeless, adjustment for demographic parameters yielded no statistically significant difference between groups.

Approximately 1.4 million persons access emergency shelters or transitional housing each year [2]. These environments have increased risk for spreading communicable diseases. Apart from studies showing increased incidence of COVID-19 in homeless shelters, this is one of the first studies to examine the rate of COVID-19 among homeless and non-homeless individuals [9,10]. During COVID-19 outbreaks in homeless shelters in San Francisco, researchers found a 66% positivity rate among shelter residents compared to the community incidence of 5.7% [9]. Other literature was speculative and warned of impending crisis among the homeless population [11].

This study's lack of increased incidence of COVID-19 among homeless patients, despite increased risk factors, might be explained by the increased sun exposure, more time spent outdoors, and decreased person-to-person contact. Research on the protective effect of vitamin

D against COVID-19 infection has conflicting conclusions. One study from University of Chicago found increased risk of COVID-19 infection among vitamin D insufficient patients and black individuals, while another study from the United Kingdom demonstrated COVID-19 infection had no link with ethnicity or vitamin D levels [12,13]. A meta-analysis found no difference in infection rate by vitamin D levels, but those with deficiency were more likely to have severe cases [14]. Homeless individuals may actually practice relative socially distancing by spending the majority of their days outdoors and in general having less employment. Some speculate that consistent baseline exposure to unhygienic environments bolsters the immune system (Herzberg Motivation Hygiene Theory).

ULH ED performed COVID-19 testing on all symptomatic patients in the ED and all admitted patients regardless of symptoms. Studies have shown a high incidence of asymptomatic COVID-19 at some homeless sites [10,15]. Homeless individuals may have fewer symptoms with COVID-19 infection and thus be less likely to seek testing. Consequently, the true prevalence of COVID-19 in the homeless patients who utilize our ED could be underestimated.

With the numerous risk factors that homeless patients face, one could expect a higher admission rate among the homeless population for COVID-19. However, homeless patients in our study were less likely to be admitted to either the ICU or hospital. This contrasts with previous studies demonstrating homelessness as an independent risk factor for admission [5]. The lower homeless admission rate, in light of SARS-CoV-2 screening of all admitted patients, could indicate a relative undercapture of COVID-positive homeless patients.

This study has several limitations. First, this is a retrospective, single center study. With data from only one ED, it is difficult to capture population data on all homeless individuals in the city. Homeless patients are known to visit multiple EDs which could lead to COVID-19 positive individuals being missed. However, as the only academic hospital in the city, ULH serves a large portion of the indigent population. Second, the demographics and climate of Louisville's population may differ from other areas of the country. Compared to northern cities, Louisville does not experience freezing outdoor temperatures for as much of the year. Third, possible confounding variables were not examined, such as patient access to personal protective equipment (PPE), access to primary care providers, body mass index (BMI), vitamin D status, amount of time spend outside, or coexisting substance use. Each of these factors could potentially confound the comparison between homeless and non-homeless individuals.

Given the data from this study, homelessness was not an independent risk factor for COVID-19 infection. Further research on this topic is needed.

Funding

The authors have no funding to report.

Credit author statement

Martin Huecker and Jacob Shreffler started a homelessness in the Emergency Department database. Andrew Polites and Katie Wilmes coded electronic medical record exports to classify patients into cohorts. Mathew Keller devised the research question related to prevalence of COVID-19 in homeless vs non-homeless. Keller wrote the first draft of the manuscript and served as corresponding author. Jacob Shreffler performed the statistical analyses in the original and revision. Martin Huecker and Jacob Shreffler supervised/mentored Keller, Wilmes, and Polites during the process. All authors discussed the results and contributed to the final manuscript.

Declaration of Competing Interest

The authors have no conflicts of interest to report.

Acknowledgements

The authors would like to thank Alyssa Thomas, Research Coordinator in the Department of Emergency Medicine, for her help on this manuscript.

References

[1] Bajgain KT, Badal S, Bajgain BB, Santana MJ. Prevalence of comorbidities among individuals with COVID-19: a rapid review of current literature. Am J Infect Control. 2021;49(2):238–46. https://doi.org/10.1016/j.ajic.2020.06.213.

[2] Henry Meghan, et al. 2017 Annual Homeless Assessment Report (AHAR) to Congress. Part 1: Point-in-Time Estimates of Homelessness. Washington, DC: US Department of Housing and Urban Development; 2017.

[3] Doran KM, Rahai N, McCormack RP, et al. Substance use and homelessness among emergency department patients. Drug Alcohol Depend. 2018;188:328–33. https://doi.org/10.1016/j.drugalcdep.2018.04.021.

[4] Lamparter LE, Rech MA, Nguyen TM. Homeless patients tend to have greater psychiatric needs when presenting to the emergency department. Am J Emerg Med. 2020;38(7):1315–8. https://doi.org/10.1016/j.ajem.2019.10.012.

[5] Fazel S, Geddes JR, Kushel M. The health of homeless people in high-income countries: descriptive epidemiology, health consequences, and clinical and policy recommendations. Lancet. 2014;384(9953):1529–40. https://doi.org/10.1016/S0140-6736(14)61132-6.

[6] Tsai J, Wilson M. COVID-19: a potential public health problem for homeless populations. Lancet Public Health. 2020;5(4):e186–7. https://doi.org/10.1016/S2468-2667(20)30053-0.

[7] Okonkwo NE, Aguwa UT, Jang M, et al. COVID-19 and the US response: accelerating health inequities. [published online ahead of print, 2020 Jun 3]. BMJ Evid Based Med. 2020;26(4):176–9. https://doi.org/10.1136/bmjebm-2020-111426.

[8] Tsai J, Doran KM, Rosenheck RA. When health insurance is not a factor: national comparison of homeless and nonhomeless US veterans who use Veterans Affairs Emergency Departments. Am J Public Health. 2013;103(Suppl. 2):S225–31. https://doi.org/10.2105/AJPH.2013.301307.

[9] Mosites E, Parker EM, Clarke KEN, et al. COVID-19 Homelessness Team. Assessment of SARS-CoV-2 Infection Prevalence in Homeless Shelters - Four U.S. Cities, March 27–April 15, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(17):521–2. https://doi.org/10.15585/mmwr.mm6917e1.

[10] Tobolowsky FA, Gonzales E, Self JL, et al. COVID-19 Outbreak Among Three Affiliated Homeless Service Sites - King County, Washington, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(17):523–6. https://doi.org/10.15585/mmwr.mm6917e2.

[11] Miller JP, Phillips G, Hutton J, et al. COVID-19 and emergency care for adults experiencing homelessness. Emerg Med Australas. 2020;32(6):1084–6. https://doi.org/10.1111/1742-6723.13652.

[12] Meltzer DO, Best TJ, Zhang H, Vokes T, Arora VM, Solway J. Association of vitamin D levels, race/ethnicity, and clinical characteristics with COVID-19 test results. JAMA Netw Open. 2021;4(3):e214117. https://doi.org/10.1001/jamanetworkopen.2021.4117.

[13] Hastie CE, Mackay DF, Ho F, et al. Vitamin D concentrations and COVID-19 infection in UK Biobank. Diabetes Metab Syndr. 2020;14(4):561–5. https://doi.org/10.1016/j.dsx.2020.04.050 [Erratum in: Diabetes Metab Syndr. 2020 Sep - Oct;14. 5.: 1315–1316. PMID: 32413819; PMCID: PMC7204679].

[14] Pereira M, Dantas Damascena A, Galvão Azevedo LM, de Almeida Oliveira T, da Mota Santana J. Vitamin D deficiency aggravates COVID-19: systematic review and meta-analysis. Crit Rev Food Sci Nutr. 2020:1–9. https://doi.org/10.1080/10408398.2020.1841090.

[15] Baggett TP, Keyes H, Sporn N, Gaeta JM. Prevalence of SARS-CoV-2 infection in residents of a large homeless shelter in Boston. JAMA. 2020;323(21):2191–2. https://doi.org/10.1001/jama.2020.6887.