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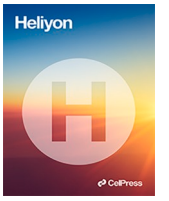

Research article

The two-year epidemiological investigation of the COVID-19 pandemic in the nomadic population of Fars province, Southern Iran: An ecological study (February 20, 2020, to February 19, 2022)

Alireza Mirahmadizadeh [a], Ahad Amiri Gharghani [b], Alireza Heiran [a], Nadia Rahimpour [c,*]

[a] Non-communicable Diseases Research Center, Shiraz University of Medical Sciences, Shiraz, Iran
[b] Shiraz University of Medical Sciences, Shiraz, Iran
[c] Social Security Insurance, Shiraz, Iran

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ABSTRACT

Background: The COVID-19 pandemic has highlighted the vulnerability of traveling populations, yet little is known about the health status of nomadic communities. This ecological study aimed to investigate the health status of the nomadic population in Fars Province, Iran, during the first two years of the COVID-19 pandemic.

Methods: Nomadic Information Registration System (NIRS) data were used to compare COVID-19 diagnostic tests, confirmed cases, referrals, hospital admissions, deaths, and vaccination coverage between the nomadic and general populations. Non-parametric chi-square test was used for data analysis.

Results: In Fars Province, COVID-19 diagnostic tests were performed on 2.73 % of the nomadic population and 40 % of the general population. The test positivity rate was 23.91 % for the nomadic population and 29.3 % for the general population. The case fatality ratio (CFR) for COVID-19 was 9.24 % for the nomadic population and 1.29 % for the general population. Additionally, only 41.83 % and 24.35 % of the nomadic population had received the first and second doses of a COVID-19 vaccine, respectively, which were lower than the general population's rates of 65.65 % and 59.71 %.

Conclusion: The nomadic population in Fars Province received suboptimal COVID-19 care compared to the general population.

1. Introduction

The COVID-19 pandemic has had a profound impact on the welfare, quality of life, livelihood, and health of all populations, with vulnerable communities facing heightened challenges [1]. The extent of vulnerability is influenced by various factors, including the local environment, healthcare resources, effectiveness of governmental programs, quality of public health infrastructures, and

* Corresponding author.
E-mail addresses: mirahmadia@sums.ac.ir (A. Mirahmadizadeh), a.amirigharghani@gmail.com (A.A. Gharghani), heiran.alireza@gmail.com (A. Heiran), rahimpourpt@gmail.com (N. Rahimpour).

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accessibility to local information [2].

Among the vulnerable populations, traveling nomadic communities may face unique challenges during the COVID-19 pandemic. They are inherently very mobile and experience a variety of geographical, social dynamics, cultural, and language barriers, hindering continuous access to healthcare and therapeutic services. In addition, based on knowledge from previous infectious disease control programs, nomadic populations might experience information gaps regarding COVID-19 spread and preventive measures, compounded by economic difficulties [3,4].

Recent studies have underscored the heightened vulnerability of certain nomadic populations, such as the Gypsy, Roma, and Traveler (GRT) communities, to COVID-19, with increased risks of infection, mortality, and various socio-economic impacts [5]. However, the nomadic lifestyle's outdoor exposure could potentially offer health benefits, including physical activity encouragement, psychological stress relief, recovery from memory impairment and concentration problems, enhanced sense of well-being, and improved social cohesion [6].

The nomadic population of Fars Province, Southern Iran, comprising over 27,000 households and 147,800 individuals – representing 12.5 % of the nomadic population of Iran – faces unique challenges during the pandemic [4,7]. According to the Union of Indigenous Nomadic Tribes of Iran (UNINOMAD), despite their isolation offering some protection, the impending migration season (i.e., spring) raises concerns about increased contact with urban and rural populations [8]. Nevertheless, scientific assessments of nomadic populations' health status during the COVID-19 pandemic are scarce, necessitating a comprehensive investigation.

In the context of the COVID-19 pandemic, considerations related to vaccination acceptance among travelers have gained prominence [9–13]. Studies focusing on COVID-19 vaccinations and acceptance among travelers are limited, emphasizing the need to explore these dynamics [14–16]. Radic et al. [14], highlighted the direct influence of awareness, responsibility, and personal norms on COVID-19 vaccination acceptance, with mass media playing a significant role [14]. Gursoy et al. [15], conducted a study on travelers' willingness to take the COVID-19 vaccine, noting increased pro-vaccine behavior with greater vaccine availability. Suess et al. [16], applied the Health Belief Model to examine travelers' willingness to receive the COVID-19 vaccine, emphasizing the impact of mass media on travelers' beliefs and trust regarding COVID-19 risks. However, most of these studies have been focused on the regular travelers rather than indigenous nomadic population, which might have different health dynamics.

The socio-economic and demographic landscape significantly shapes consumer behavior, impacting vaccine hesitancy. Identifying hesitant groups, such as younger travelers and specific ethnicities, becomes crucial for targeted communication strategies. Younger age groups demonstrate lower vaccine hesitancy, while African American and Hispanic/Latino travelers express higher hesitancy [15]. Gender, age, education, and residence are pivotal determinants influencing travelers' vaccination intentions [15,17,18].

With the unpredicted diverse and variable needs exerted by the emergence of COVID-19 pandemic, it appears that the public welfare depends on the efficiency of performance directed by institutions and organizations [19]. Despite implementation of various specific mitigating, monitoring, tracking and treatment strategies among minority groups, especially the nomads, by the Iran government to fight against COVID-19, there is a need to examine the results of such programs using real-world data [20]. Our ecological investigation aims to contribute to this discourse by assessing the health status of the nomadic population in Fars Province, Southern Iran during the first two years of the COVID-19 pandemic. Understanding these dynamics will not only inform public health strategies but also shed light on the intersection of nomadic lifestyles, COVID-19 vulnerability, and vaccination acceptance, offering valuable insights for future research and policy considerations.

2. Materials and methods

This exploratory study, employing an inductive approach [21,22] used quantitative ecological data encompassing all nomadic subpopulations exclusively move cyclically or periodically in Fars Province, located in Southern Iran, during the first two years of the COVID-19 pandemic, from February 20, 2020 (the announcement of the COVID-19 pandemic status in Iran) to February 19, 2022.

Data for this study were acquired through the Nomadic Information Registration System (NIRS), an electronic health record system established under the supervision of the Ministry of Health and Medical Education (MOHME) before the COVID-19 pandemic. It should be noticed that the NIRS was assessed through the "nomadic population-related system gharbalgari_ashayer_1400.qvw" portal. This system had been designed to record various medical conditions among the Iranian nomadic population by aggregating and de-duplicating manual data acquired from all nomadic health centers in Iran. Worth noting, in Iran, these distinct centers have been established in the form of mobile shelters located on the nomads' seasonal migration route to facilitate their access to health services in addition to regular urban and rural health centers. By emerging the COVID-19 pandemic, NIRS underwent revision in the autumn of 2020 to include reported data on COVID-19 among nomadic populations. Initially, COVID-19 testing information was recorded, and with the commencement of national vaccination campaigns, the portal was updated with COVID-19 vaccination data (i.e., dose, type, date). Data collected in NIRS were meticulously monitored until the winter of 2022. Since this study was limited to the nomadic population of Fars Province, a non-random availability sampling method was employed to include data from all nomadic individuals in the Fars province whose information was accurately recorded on the Ministry of Health's portal.

Upon obtaining research ethics code from the Research Ethics Committee of Shiraz University of Medical Sciences (code: IR.SUMS.SCHEANUT.REC.1401.070), the principal researcher assessed the portal to collect data. NIRS includes aggregated counts of tests performed to diagnose COVID-19 (RT-PCR and rapid testing), positive tests, referrals to selected primary and secondary (outpatient) health sectors or centers, referrals and admissions to tertiary referral hospitals, deaths due to COVID-19, and vaccination coverage. To prevent duplicated or missed cases, the national identification codes of the individuals obtained from the portal were cross-checked with the manual statistics of nomadic health centers in all 37 counties of Fars Province.

Furthermore, to compare the aforementioned statistics between the nomadic population and the general population of Fars

Province, the CORONALAB, Medical Care Monitoring Center (MCMC), and the management dashboard of COVID-19 databases were used to obtain general population statistics [23]. The CORONALAB repository contains data on all individuals from general population who underwent a COVID-19 RT-PCR test in public or private centers at the beginning of the COVID-19 pandemic. Moreover, the MCMC repository includes data on all clinically suspected and confirmed COVID-19 hospital admissions, between-ward and between-hospital transfers, and hospital deaths in Fars Province.

Statistical analysis was carried out using IBM SPSS (Statistical Package for the Social Sciences; IBM Corp, Armonk, NY, USA) software, version 26 for Microsoft Windows. The findings were reported using count, ratio, and rate. The non-parametric chi-square test was used to assess the difference between indices, with a significance level set at less than 0.05. Considering ethical issues, since aggregated count data were used in ecological studies, the evaluated data did not include identifiable information.

3. Results

The total population of Fars province was 5,094,000, with 91,064 individuals in the nomadic population whose information was available in the NIRS.

A significant disparity was observed in the number of tests performed between the nomadic population (2488 tests, 2.73 %) and the general population (2,037,571 tests, 40 %) ($P < 0.001$). Among these tests, 595 (23.91 %) were positive in the nomadic population, compared with 596,950 (29.3 %) in the general population, showing no statistically significant difference ($P = 0.691$) (Fig. 1).

A total of 1519 (1.66 %) nomadic individuals and 706,258 (13.9 %) individuals from the general population were referred to selected outpatient COVID-19 centers, which was significantly lower in the nomadic population ($P = 0.008$). Among these patients, 380 (25 %) nomadic patients and 8274 (1.17 %) individuals from the general population were further referred to tertiary referral hospitals due to the severity of COVID-19 ($P < 0.001$). Moreover, the rate of hospitalization for the severe COVID-19 was significantly lower among nomadic people (104 cases, 0.11 %) compared to 158,983 cases (3.12 %) in the general population ($P < 0.001$) (Fig. 2).

The mortality rate due to COVID-19 was 60 per 100,000 in the nomadic population (55 deaths in the total population of 91,064) and 151 per 100,000 in the general population (7701 deaths in the total population of 5,094,000), significantly lower among the nomadic population ($P < 0.001$). In contrast, the COVID-19 case fatality ratio (CFR) was calculated as 9.24 % in the nomadic population (55 deaths out of 595 confirmed COVID-19 patients) compared with 1.29 % in the general population (7701 deaths out of 596,950 confirmed COVID-19 patients) ($P = 0.011$).

As of February 19, 2022, 38,101 (41.83 %) and 22,180 (24.35 %) nomadic individuals received the first and second doses of a COVID-19 vaccine, respectively. These rates were 3,344,591 (65.65 %) and 3,041,779 (59.71 %) in the general population, respectively. The administration rates for both the first and second doses were significantly lower in the nomadic population ($P = 0.021$ and < 0.001, respectively) (Fig. 3).

4. Discussion

This study presents a comprehensive analysis of the 2-year COVID-19 situation among the nomadic population in Fars Province, Southern Iran, compared with the general population. The findings represent a substantial disparity in the rates of COVID-19 testing, diagnosis, hospitalization, mortality, and vaccination between the nomadic and general populations.

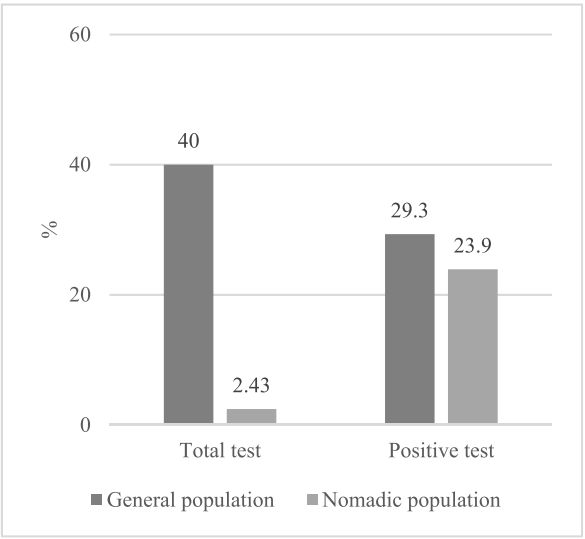

Fig. 1. Total COVID-19 diagnostic tests and positive test percentages in general population and nomadic population of Fars Province during the first two years of the pandemic.

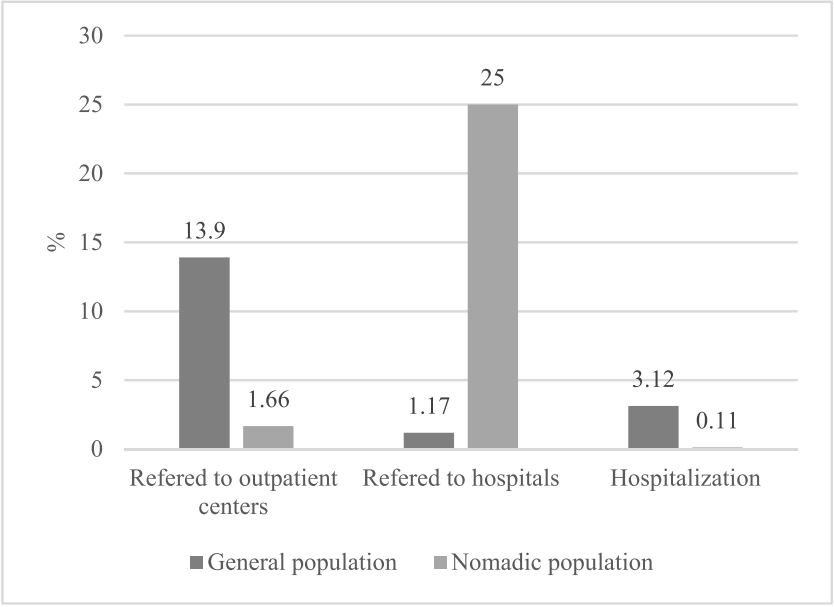

Fig. 2. Percentages of referral to the outpatient centers, referral to hospitals and hospitalization due to the COVID-19 in general population and nomadic population of Fars Province during the first two years of the pandemic.

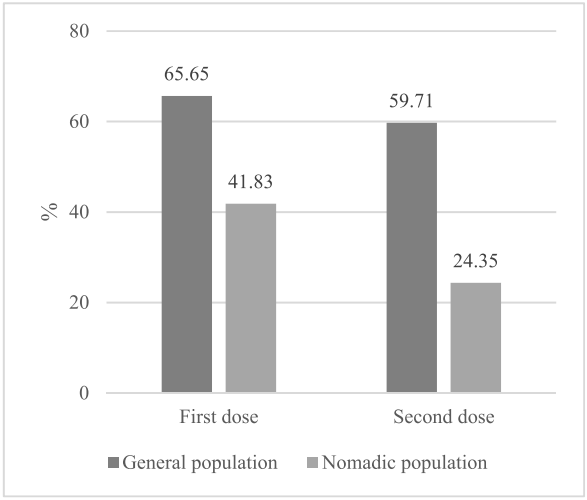

Fig. 3. Coverage of the first and second doses of COVID-19 vaccines in general population and nomadic population of Fars Province during the first two years of the pandemic.

The study indicated that only 0.65 % of the nomadic population underwent COVID-19 testing, in contrast to 11.71 % of the general population. This lower testing rate among nomads might be attributed to limited access to healthcare facilities, leading individuals with mild or no symptoms to forego seeking medical care until their conditions deteriorated. Additionally, the screening coverage for COVID-19 in the nomadic population was notably lower than that of the general population (2.73 % vs. 40 %), highlighting potential challenges in healthcare access for nomads.

Additionally, the study showed lower outpatient center visitation (1.66 % vs. 13.9 %) and hospitalization rates (0.11 % vs. 3.12 %) due to COVID-19 among the nomadic population, compared to the general population, indicating potential reluctance or delayed seeking of medical attention. However, the nomadic population showed a higher rate of referral to hospitals for severe COVID-19 cases (25 % vs. 1.17 %), suggesting that nomads might have ignored mild symptoms, refused to be screened, and only sought medical help when their condition become critical. Nonetheless, a study by Arabfard et al. [24] found no significant difference in COVID-19 prevalence between the area around Hamoun Lake, a deprived region in Iran with limited access to healthcare facilities. Therefore, it is essential to note that healthcare access alone may not be a determining factor in COVID-19 prevalence, and relying solely on official reports of confirmed cases may be insufficient for policymaking among the nomadic population [25].

The fatality indices can serve as a pivotal indicator in assessing the prevalence trend of COVID-19 in Iran [26]. We found a significantly lower mortality rate attributed to COVID-19 among the nomadic population compared to the general population in Fars Province (60 versus 151 per 100,000); However, in contrast, the COVID-19 CFR, which represents the proportion of deaths among confirmed cases, was significantly higher among the nomadic population compared to the general population (9.24 % versus 1.29 %). This discrepancy highlights an important distinction; that is, while the mortality rate reflects the overall impact of COVID-19 on the entire population, the CFR focuses specifically on confirmed cases, indicating the severity of the disease once contracted. The higher CFR among nomadic populations underscores the heightened risk of severe outcomes among those who become infected. These findings emphasize the need for targeted public health interventions tailored to the nomadic population's specific vulnerabilities, including their traveling lifestyle, prevalence of chronic conditions, and limited access to healthcare services during health crises such as the COVID-19 pandemic. In Iran, the majority of nomads lack permanent residency and dwell in portable structures such as tents. Their nomadic lifestyle involves frequent movements in small groups (2–5 families) between pastures in different cities and provinces, potentially limiting their access to public services and healthcare facilities [26]. Given the high COVID-19 mortality rate among nomads, the traveling lifestyle and lack of continuous access to medical and healthcare services could exacerbate critical conditions like the COVID-19 pandemic [7]. The nomadic population, often dealing with one or more chronic diseases, such as hypertension, diabetes, respiratory diseases, etc., may lack adequate self-care behaviors to manage their health conditions. Consequently, individuals with uncontrolled pre-existing conditions are more susceptible to suffer from a more severe COVID-19, contributing to the observed higher CFR [7]. This finding aligns with previous studies indicating a higher risk of COVID-19 fatality among indigenous minorities. Argoty-Pantoja et al. [26] showed a 64.8 % higher crude rate of COVID-19 fatality among the indigenous Mexican population compared to the non-indigenous population. Similar ethnic inequalities in COVID-19 mortality risk have been reported in the United States African-Americans, Hispanics, and Asians compared to the Caucasian population, as well as the UK and Wales blacks, Indians, Pakistanis, and Bangladeshis compared to the Caucasian population, with higher rates among minority groups [27,28]. By and large, the nomadic lifestyle's unique challenges, combined with the prevalence of chronic conditions and limited access to healthcare services, highlights the need for targeted public health interventions to address the specific vulnerabilities of the nomadic population during health crises such as the COVID-19 pandemic. Future research should delve deeper into the intricacies of nomadic healthcare access, cultural factors, and other determinants influencing COVID-19 outcomes to inform more effective public health strategies.

The vaccination rates among the nomadic population raise concerns, with only 41.83 % and 24.35 % receiving the first and second doses, respectively, compared to 65.65 % and 59.71 % in the general population, by the February 19, 2022. These vaccination rates among the nomadic population of the Fars Province might not be acceptable. This discrepancy is noteworthy, considering global efforts to promote vaccination. The American Indian and Alaska Native (AI/AN) population in the United States had the highest rates for full and first-dose vaccination among all ethnic/racial groups, suggesting potential influencers contributing to this success [29,30]. Similarly, a good perception of COVID-19 control measures among nomads observed in Cameroon, indicates the efforts of government-initiated campaigns tailored to nomadic communities [3]. Iran government also established population screening systems and continuous follow-ups through phone calls and in person from the early months of the COVID-19 pandemic, as well as the vaccination campaign to encourage and persuade the nomadic population to be vaccinated; however, the reasons behind the relatively low vaccination rates in the nomadic population of Fars Province remain unclear.

To address these disparities, comprehensive strategies are imperative: Mobile healthcare units that can reach nomadic populations in their migratory routes could enhance access to testing, vaccination, and basic healthcare services. Another step would be culturally sensitive community outreach programs that educate nomadic communities about the importance of early testing, regular healthcare check-ups, and vaccination can foster a better understanding and appreciation of healthcare practices. In addition, telemedicine initiatives can overcome geographical barriers, allowing nomads to consult healthcare professionals remotely. This approach can be particularly beneficial for addressing non-urgent health concerns and providing preventive care. Moreover, community engagement, particularly involving nomadic community leaders, can involve nomads in healthcare decision-making processes, and empower the community to take an active role in promoting health and well-being. Furthermore, developing tailored vaccination campaigns specifically designed for nomadic populations, considering their mobility and potential challenges in accessing vaccination centers, can improve vaccination coverage.

Limitations: This study possesses several limitations that should be considered when interpreting the findings. Firstly, the study relied on aggregated and ecological data, limiting our ability to provide detailed demographic information for the nomadic and general populations. Individual-level data on age, disease severity, and hospitalization criteria were not accessible, restricting the implementation of age-stratified analyses and the presentation of disease severity classifications. Moreover, the study lacked seroprevalence data and information on circulating SARS-CoV-2 variants due to the unavailability of individual-level serological assay results and variant-specific details. Despite efforts to obtain additional data from the NIRS, access to such detailed information was not granted. As a result, the study's conclusions are drawn from an exploratory and inductive approach based on the available ecological data, and the findings should be interpreted with caution in the absence of comprehensive individual-level information. The ecological nature of the study also restricted our ability to conduct longitudinal analyses, limiting the assessment of temporal trends. Additionally, the study did not have access to information on monthly reported cases for the two populations, further constraining the temporal analysis of COVID-19 incidence. These limitations highlight the need for future research endeavors with a more individual-level focus and access to detailed demographic, clinical, and serological data for a comprehensive understanding of the impact of the COVID-19 pandemic on nomadic populations.

5. Conclusion

Our two-year epidemiological investigation showed the significant healthcare disparities experienced by the nomadic population of Fars Province, Southern Iran, amidst the COVID-19 pandemic. Despite the global efforts to mitigate the spread of the virus, our findings emphasized the urgent need for targeted interventions to address the unique challenges faced by nomadic communities. The stark contrast in COVID-19 testing rates, diagnosis, hospitalization, mortality, and vaccination coverage between the nomadic and general populations shows systemic inequities in access to healthcare services. Notably, the nomadic population received suboptimal COVID-19 care compared to the general population, as evidenced by lower rates of testing, diagnosis, timely hospitalization, and vaccination, coupled with a higher case fatality ratio. The multifaceted nature of these disparities suggests a complex interplay of factors, including limited access to healthcare facilities, nomadic lifestyles hindering consistent engagement with health services, and cultural considerations influencing healthcare-seeking behavior. While governmental initiatives have been implemented to fight against the pandemic, our findings show the need for comprehensive and culturally sensitive healthcare interventions tailored to nomadic communities. Moving forward, mobile healthcare units, culturally sensitive community outreach programs, and telemedicine initiatives emerge as crucial strategies to enhance access to testing, vaccination, and basic healthcare services for nomadic populations. Moreover, community engagement, particularly involving nomadic community leaders, can empower the community to take an active role in promoting health and well-being. Our study not only highlights the urgent healthcare needs of nomadic populations but also emphasizes the importance of addressing healthcare disparities to ensure equitable and effective responses to future health crises. By prioritizing the health of disadvantaged and minority populations, particularly nomadic communities facing internal and external obstacles in accessing healthcare facilities, we can strive towards a more inclusive and resilient healthcare system.

Ethics approval and consent to participate

This study received approval from the Ethics Committee of Shiraz University of Medical Sciences (code: IR.SUMS.SCHEANUT.REC.1401.070).

Consent for publication

Not applicable.

Data availability statement

The data used in this study are not publicly available. Data will be made available on request.

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CRediT authorship contribution statement

Alireza Mirahmadizadeh: Supervision, Methodology, Formal analysis, Conceptualization. **Ahad Amiri Gharghani:** Resources, Data curation. **Alireza Heiran:** Writing – review & editing, Writing – original draft. **Nadia Rahimpour:** Supervision, Methodology, Data curation.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Alireza Mirahmadizadeh reports financial support was provided by Shiraz University of Medical Sciences.

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