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## Abstract

**Background**: The coronavirus disease 2019 (COVID-19) pandemic has rapidly spread to most countries around the world. Disproportionate spread of COVID-19 among the Indian community in Kuwait prompted heightened surveillance in this community.

**Aims**: To study the epidemiological characteristics of COVID-19 patients and their contacts among the Indian community in Kuwait.

**Methods**: Data collection was done as a part of contact tracing efforts undertaken by the Kuwaiti Ministry of Health.

**Results**: We analysed contact-tracing data for the initial 1348 laboratory-confirmed Indian patients and 6357 contacts (5681 close and 676 casual). The mean (standard deviation) age of the patients was 39.43 (10.5) years and 76.5% of the cases were asymptomatic or had only mild symptoms. Asymptomatic patients were significantly older [40.05 (10.42) years] than patients with severe symptoms [37.54 (10.54) years] (P = 0.024). About 70% of the patients were living in shared accommodation. Most of the close contacts were living in the same household, as compared with casual contacts, who were primarily workplace contacts (P

**Conclusion**: An early increase in the number of COVID-19 cases among the Indian community could be primarily attributed to crowded living conditions and the high proportion of healthcare workers in this community.

Keywords: contact tracing, COVID-19, epidemiology, Kuwait, SARS-CoV-2.

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## Introduction

The coronavirus disease 2019 (COVID-19) pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has rapidly spread to most countries around the world. Over 35.6 million cases of COVID-19, including > 1 million deaths, had been reported worldwide as of 8 October, 2020 (1). Experience from countries like the United States of America and Italy has demonstrated how quickly the healthcare system can be overwhelmed if the number of cases keeps increasing. Epidemiological models of the spread of SARS-CoV-2 suggest that, unless robust community containment measures are adopted, 40–70% of the population could become infected (2).

The first reported case of COVID-19 in Kuwait occurred in the last week of February 2020. As of 8 October, 2020, the Kuwaiti Ministry of Health (MoH) had reported about 109 000 confirmed COVID-19 cases, including 639 deaths, with a recovery rate of 92.7% and fatality rate of 0.6% (3). The initial cases were mostly related to international travel, but soon with the emergence of local transmission, the disease began to spread rapidly throughout the country ( Figure 1 ). Various public health measures have been successfully implemented by countries to contain COVID-19. The World Health Organization (WHO) recommends a combination of measures: rapid diagnosis and immediate isolation of cases, and rigorous tracking and precautionary self-isolation of close contacts (4). Peto suggested that a policy of population-wide testing and contact tracing would help to rapidly end the pandemic (5). Several countries have credited aggressive contact tracing in containing the spread of the pandemic (6,7).

A recent study that used a stochastic transmission model of COVID-19 predicted that 70% of contacts should be traced and quarantined to control a pandemic, if the basic reproduction number (R0) is assumed to be 2.5 (8). A recent review of 12 studies form China and overseas estimated the mean R0 for COVID-19 to be around 3.28, with a median of 2.79 (9). This indicates that 50–70% of possible transmissions should be prevented to bring the R0 value to

Kuwait adopted a strategy of using widespread testing and isolation of cases followed by contact tracing and quarantine of the contacts. There was a clear pattern in the communities affected with COVID-19. In the first few weeks of April 2020, as high as 80% of the total COVID-19 cases in Kuwait were among Indians ( Figure 1 ). By the end of May 2020, the distribution of COVID-19 was about 30% among Indians, followed by Kuwaitis (20%), Egyptians (18%) and Bangladeshis (11%) and other communities (21%) (3). It was necessary to conduct a detailed analysis of the characteristics of the initial cases of COVID-19 affecting Indians to gain better understanding of the causes for the disproportionate spread of the disease in this community.

Using the data obtained through contact tracing (February to May 2020), we present the demographic characteristics of the initial 1348 COVID-19-positive Indian patients and 6357 of their contacts.

## Methods

### Kuwait's surveillance and contact tracing strategy

Data collection was done as a part of contact tracing efforts undertaken by the MoH for surveillance purposes. Review Board approval for this case series study was obtained from the Research Sector of the MoH. Verbal consent was obtained from all patients and their contacts. Suspected cases and their close contacts were tested for SARS-CoV-2 by reverse transcription polymerase chain reaction (RT-PCR) of nasal/throat swabs at the MoH-designated COVID-19 testing centres. All confirmed cases that were asymptomatic were isolated at the central facilities and those who were symptomatic were admitted to the designated area hospitals. Any individual with symptoms after exposure to the case was referred to hospital for isolation and testing as part of active case finding. Close contacts were all placed under mandatory quarantine for 14 days from their last date of exposure and were either shifted to designated centres or advised to self-isolate.

## Definitions

A confirmed case was a person with laboratory confirmation of SARS-CoV-2 by RT-PCR, irrespective of clinical signs and symptoms. Cases exhibiting signs of respiratory distress or any other severe disease complications that required hospitalization for management were classified as severe cases (10). A close contact was anyone who had spent > 15 minutes in direct face-to-face contact within 2 m of a confirmed case, lived in the same household, or shared any leisure or professional activity in close proximity with a confirmed case without appropriate personal protective equipment in any setting, 2 days before symptom onset (or, for asymptomatic patients, 2 days prior to positive specimen collection) until the time the confirmed case was isolated. A casual contact was a person who had a close ( **Workflow for contact tracing**

A central command centre for conducting contact tracing was established by the Public Health Department, MoH, Kuwait. Contact tracing of Indian patients posed additional challenges due to the different languages spoken by the community. The MoH decided to train voluntary Indian healthcare professionals, speaking different Indian languages, to conduct contact tracing. A total of 71 voluntary doctors/dentists were trained to conduct contact tracing using standardized interview schedules.

Field coordinators received the daily list of laboratory-confirmed SARS-CoV-2-positive Indian cases from the MoH. Multilingual coordinators contacted the cases and recorded the patients' preferred language for communication and then assigned the cases to the volunteer doctors for contact tracing. Assigned volunteers contacted the patients by telephone and collected the movement history 2 days prior to symptom onset until isolation. The following data were collected from every patient: demographic characteristics, travel history, date of onset of symptoms, date of testing, date of isolation and details of contacts.

In the next stage, the volunteers contacted all the close and casual contacts of the patients and advised them appropriately. Close contacts were advised home quarantine for 14 days after their last exposure to the patient. All contacts were advised to go for testing if they developed any relevant symptoms and the details of the nearest COVID-19 testing centre were provided. Information collected was entered into a predesigned form and was submitted back to the MoH after cross-verification. The entire process was conducted in a time-bound manner. The MoH passed on the relevant information to its field teams to facilitate isolation of cases and quarantine of contacts. Volunteer teams also helped the MoH to identify new COVID-19 hotspots and high-risk cases/contacts.

### Statistical analysis

Statistical analysis was carried out using IBM SPSS Statistics for Windows version 25.0 (Armonk, NY, USA). Analyses included frequency distributions, $\chi 2$ and Fisher's exact tests when categorical variables were compared and t-tests for continuous variables.

## Results

### Characteristics of the initial COVID-19 Indian patients

We analysed the contact tracing data for the initial 1348 laboratory-confirmed cases of COVID-19 among Indian patients and 6357 contacts (5681 close and 676 casual). The median number of contacts per case was 4 (range 0–21). Geographical distribution according to the place of residence of the cases in each of the 6 Governorates of Kuwait is shown in Figure 2 . Most patients belonged to the Indian states of Kerala (35%), Rajasthan (14%), Tamil Nadu (9%) and Andhra Pradesh (9%). Among the 1348 confirmed cases of COVID-19, 1031 (76.5%) were asymptomatic or had only mild symptoms and 317 (23.5%) had severe symptoms ( Table 1 ). The mean (standard deviation) age of the patients was 39.43 (10.5) years. Asymptomatic patients were significantly older [40.05 (10.42) years] than patients who had severe symptoms [37.54 (10.54) years] (P = 0.024). Most (68.8%) of the patients were living in shared accommodation. There was no significant difference between severe and mild cases in relation to their type of accommodation. Among the different occupations, healthcare workers had the highest proportion of cases (18.4%) and unemployed individuals had the least (4.1%). The mean time interval from symptom onset (or, positive specimen collection for asymptomatic

patients) to isolation was 3.78 (4.57) days [median 3 days and interquartile range (IQR) 1–6 days]. Less than 5% of the cases were isolated before symptom onset and most cases (65.5%) were isolated between days 1 and 10. There was a significant difference between symptomatic and asymptomatic patients in relation to the date of isolation (P

**Characteristics of contacts**

About 90% of the contacts traced were categorized as close contacts ( Table 2 ). There was a significant difference in the age distribution between close and casual contacts, with a higher proportion of close contacts belonging to the younger age group (P

**Index and secondary case pairs**

There were 216 pairs of cases with a clear relationship between the index and secondary cases ( Table 3 ). Based on the difference in the time of onset of symptoms between the 2 groups, the mean serial interval (the time from illness onset in the index case to illness onset in a secondary case) was estimated to be 3.89 (3.69) days (median 3 days, IQR 1–5 days).

## Discussion

Our analysis of the initial COVID-19 cases among Indians in Kuwait and their close contacts provides valuable insights into the epidemiological characteristics of the pandemic in this community. Many unique characteristics that might have contributed to the rapid spread of the disease were observed among the cases.

We calculated the mean serial interval to be about 3.89 days, which is similar to the values reported by Zhao et al. (11) and Nishiura et al. (12), who estimated a serial interval of 4.4 and 4.0 days, respectively. However, initial studies from Wuhan, China estimated the mean serial interval to be 7.5 days, based on contact tracing data (13). Estimates of the serial interval are obtained by linking the dates of onset for infector–infectee pairs, which are difficult to establish and might explain the variations across populations. Several studies have calculated the serial interval of COVID-19 to be shorter than the mean incubation period of the disease, which indicates rapid cycles of transmission and substantial presymptomatic transmission (12).

The highest number of cases were reported among healthcare workers as compared with all other professions. A high proportion of the nursing staff in Kuwait are Indians (14,15). Nurses

are often the front-line workers managing COVID-19 patients. The high number of cases among healthcare workers put unprecedented strain on the healthcare system. The WHO has issued guidelines for protection of healthcare workers that recommend contact and droplet precautions for those caring for suspected COVID-19 patients (16). However, a recent study has shown that airborne precautions are more efficacious in protecting healthcare workers even when infections are assumed to be spread by the droplet route (17). Since the ability of a country to respond effectively to COVID-19 relies on its healthcare workforce, it is of paramount importance to ensure a safe work environment for healthcare workers.

Most of the patients were either asymptomatic or had mild symptoms, which is similar to the reports from other countries (18,19). When a substantial proportion of cases are asymptomatic, prevention becomes extremely challenging. Also, unlike SARS, for which most transmission occurred after symptom onset (20), COVID-19-positive cases are infectious even before symptom onset (21). He et al. (22) reported that > 40% of the of secondary cases were infected during the presymptomatic stage of the index cases. This contributes to the rapid spread of the disease, especially when public health measures are not strictly enforced. Since most of the cases were employed, workplace safety was given high priority. Kuwait was quick to adopt a nationwide policy of social distancing and compulsory wearing of facemasks in all public spaces and workplaces, which was enforced in early May.

For contact tracing to be effective, secondary cases should be discovered before they become infectious; hence the time from the primary case becoming infectious to the tracing of their contacts needs to be shorter than the incubation period (23). As recommended by the WHO, isolation of cases (either self- or hospital isolation) soon after disease confirmation is important to minimize the spread of infection (24). The average time to isolation in this study was 3.78 days which is similar to time reported in other studies. Bi et al. (25) reported a mean time to isolation of 4.6 days and 2.7 days for symptom-based and contact-based surveillance groups, respectively.

According to He et al. (22), the highest viral loads were detected soon after symptom onset, which then gradually decreased towards the detection limit at about day 21. Since most patients in this study were living in shared accommodation, this could have contributed towards the rapid spread of the disease in this community. The MoH undertook several measures to avoid a delay in isolation. A 24/7 COVID-19 telephone hotline was introduced, where the patients could call for information and assistance. Dedicated ambulance services were employed to transfer suspected or confirmed cases of COVID-19. However, due to the sudden increase in numbers of cases, the healthcare system in Kuwait was quickly overwhelmed. The MoH quickly responded by opening new field hospitals to meet the increasing demand for hospital beds.

One of the most important public health measures to control the spread of infectious diseases is contact tracing (23). From the initial days of the pandemic, the MoH focused its efforts on widespread testing and isolation followed by contact tracing and quarantine of contacts. Contact tracing helps to identify contacts, who are then advised to quarantine (26). Contact tracing was largely credited with the success in controlling the 2003 SARS pandemic. The MoH cast a wide net while conducting contact tracing to identify all the contacts of the cases. To achieve this goal, the definition of contacts included 2 days prior to symptom onset of the case, as has been done in Hong Kong and Mainland China (8). Based on the daily analysis of the data obtained through contact tracing, the MoH was able to identify the hot spots and prioritize assistance ( Fi gure 2 ).

Several community containment measures were initiated in Kuwait, such as mass fever screening, border restrictions, full/partial curfew, quarantine of buildings, community education and precautions, in addition to multiple social and economic activity restrictions to suppress transmission. Stringent border control measures helped to reduce the number of imported cases, which could have initiated multiple new local chains of transmission. Kuwait instituted nationwide complete lockdown from 10 to 31 May 2020 and currently has enforced partial lockdown. Lockdowns help by reducing the movement of people and, coupled with widespread testing and contact tracing, contribute to limiting the spread of the disease. A study from Italy reported that strict enforcement of a nationwide lockdown significantly contributed to reducing the number of new cases (27). In addition, the MoH expanded testing to include sentinel locations such as supermarkets, gas stations, and other critical locations that involved high levels of human interaction, to identify areas that could have been involved in community spread of COVID-19. Multiple surveillance mechanisms are required to ensure wide coverage because each missed case can initiate a new chain of transmission (28).

One of the major strengths of this study was the large number of cases that were analysed. Also, language competence between the interviewer and the patients was ensured, which is essential while conducting telephone interviews. The present study had some limitations. Firstly, there was potential for recall bias as data collection was done through telephone interviews. However, considering the circumstances, telephone data collection can be considered as a pragmatic and feasible option. Secondly, we used 2 days before symptom onset as the starting date for contact tracing in contrast to some studies that used 4 days (21). Reducing the time period in the definition of a contact might have increased the risk of undetected contacts. However, this may not have been significant in this population as most of the contacts were household contacts. Thirdly, cases were identified from a daily list obtained from the MoH. As a result, there may have been selection bias, where individuals belonging to a certain region or occupation were prioritized for contact tracing. Finally, as with any pandemic response, the initial surveillance was primarily symptom-based, therefore, it is likely that asymptomatic cases would have been missed. These limitations limit our ability to generalize the results.

## Conclusions

An early increase in the number of COVID-19 cases among the Indian community in Kuwait could be primarily attributed to crowded living conditions and the high proportion of healthcare workers in this community. Aggressive contact tracing followed by immediate isolation of cases and quarantine of close contacts play a vital role in breaking the local chains of transmission. However, contact tracing is a resource-intensive activity that is difficult to sustain in the long run. Also, the longer the pandemic lasts, the higher will be community transmission, making it difficult to link the contacts with cases.

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**Competing interests**: None declared.

## Caractéristiques épidémiologiques des cas de COVID-19 chez les Indiens résidant au Koweït

### Résumé

**Contexte** : La pandémie de maladie à coronavirus 2019 (COVID-19) s'est rapidement propagée vers la plupart des pays du monde. La propagation disproportionnée de la COVID-19 au sein de la communauté indienne du Koweït a incité à une surveillance accrue de cette communauté.

**Objectifs** : Étudier les caractéristiques épidémiologiques des patients atteints de COVID-19 et de leurs contacts au sein de la communauté indienne du Koweït.

**Méthodes** : La collecte des données a été effectuée dans le cadre des efforts de traçage des contacts menés par le ministère de la Santé koweïtien.

**Résultats** : Nous avons analysé les données relatives à la recherche des contacts pour les 1348 patients indiens initiaux confirmés en laboratoire et les 6357 contacts (5681 contacts rapprochés et 676 occasionnels). L'âge moyen (écart type) des patients était de 39,43 ans (10,5) et 76,5 % des cas étaient asymptomatiques ou ne présentaient que des symptômes légers. Les patients asymptomatiques étaient significativement plus âgés [40,05 ans (10,42)] que les patients présentant des symptômes graves [37,54 ans (10,54)] p = 0,024). Environ 70 % des patients résidaient dans un logement partagé. La plupart des contacts rapprochés vivaient dans le même foyer, alors que les contacts occasionnels étaient principalement des contacts sur le lieu de travail (p

**Conclusion** : Une augmentation précoce du nombre de cas de COVID-19 au sein de la communauté indienne pourrait être principalement attribuée aux conditions de surpeuplement des logements et à la forte proportion d'agents de santé dans cette communauté.

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