



Epidemiological characterization of symptomatic and asymptomatic COVID-19 cases by using RT-PCR tests at a tertiary care hospital, Bhavnagar

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Abstract

Introduction: In December 2019, a new respiratory illness caused by a coronavirus was identified in China, and then it was subsequently named COVID-19. Symptoms may be present or absent in patients which confirmed by COVID-19 RT-PCR tests. Viral loads from asymptomatic and symptomatic COVID-19 infections were found to be similar. This study was conducted at tertiary care hospital, Bhavnagar with the aim of epidemiological characterization of COVID-19 cases regarding its symptom's presentation using RT-PCR testing.

Material and method: In this retrospective observational study, A total of 985160 samples were received for COVID-19 RT-PCR testing at the Viral Research and Diagnostic Laboratory Centre between March 2020 and September 2023. All samples were analysed for various demographic data.

Results: Of the 985160 samples tested, 22640 (2.29%) samples had positive COVID-19 testing results. Among the positive samples, 36.96% were female and 63.03% were male. The majority of the individuals (40.4%) belonged to the age group of 21–40 years. Of the individuals in a symptomatic condition, 24.43% were symptomatic and 75.56% were asymptomatic.

Conclusion: There are many asymptomatic carriers of COVID-19, and the incidence is high among them. Therefore, continuous surveillance, monitoring, and home isolation of asymptomatic carriers are required to reduce the transmission of infection during the current and future pandemics.

Keywords: RT-PCR testing, COVID-19 infection, transmission rate, asymptomatic carriers.

Introduction

Severe acute respiratory syndrome (SARS) associated coronavirus also known as SARS-CoV, was first identified as a novel coronavirus in the year 2002. [1,2] A initial source for this virus is believed to have been Himalayan masked palm civet cats, but it has also been isolated from other animals, such as Chinese ferret badgers. [3,4] The global outbreak of the novel coronavirus-SARS in 2002 and 2003 renewed interest of this virus and its implications for both animals and humans. It caused severe respiratory distress in humans and is believed to have originated in China, prompting extensive research and heightened public health measures worldwide. [1,2,4]

A group of viruses known as coronaviruses, members of the Coronaviridae family, can infect both humans and animals. Coronaviruses are an enveloped RNA viruses that have petal, crown, or club-shaped glycoprotein peplomers on their surface, which creates the appearance of a solar corona. [1, 2, 5, 6] Coronaviruses are large (120–160 nm) pleomorphic or roughly spherical viruses with a helical symmetry. They contain a single-stranded, non-segmented, plus-sense RNA virus. The length of it is approximately 30 kb. [2,5,7]

Following that, in December 2019, Wuhan, situated in Hubei Province, China, reported the first case of respiratory illness caused by the novel coronavirus. [5, 8, 9] Following its identification, the novel coronavirus was named SARS-CoV-2. The disease caused by SARS-CoV-2 was subsequently recognized as COVID-19 by the World Health Organization (WHO). [10, 11] Since the initial cases were reported, several confirmed cases have been reported in many countries. A medical student returning from Wuhan University of China unknowingly carried the virus. On 30th January, 2020, they tested positive for COVID-19 in Kerala, marking the first confirmed case in India. [5,12,13] Then, the World Health Organization (WHO) officially classified COVID-19 as a pandemic on March 11, 2020. [14] subsequently, On March 19, 2020, the first two COVID-19 cases in Gujarat were confirmed in Rajkot and Surat. [15]

The states reported an ongoing increase in COVID-19 cases during the following periods. Thus, in an effort to prevent the spread, the state's health authorities implemented and expanded laboratory-based surveillance, standard infection control, and public health measures. These measures included screening for influenza-like illness, conducting tests, tracking contacts of infected individuals, and isolating those who tested positive for COVID-19. [16]

The COVID-19 is transmitted by respiratory droplets and contact routes. In some aerosol-generating procedures, transmission of the COVID-19 virus may occur. An individual infected with COVID-19 may not show any symptoms (asymptomatic) or may experience a wide range of symptoms. These symptoms can include fever, cough, and difficulty in breathing (dyspnea). In severe cases, COVID-19 can progress to pneumonia and acute respiratory distress syndrome (ARDS), requiring mechanical ventilation and additional oxygen support. [1, 2, 4, 7] While around 80% of COVID-19 infections cause mild illness or no symptoms at all, a significant portion of cases, about 15%, take a turn for the worse, requiring oxygen support. The most concerning scenario, affecting roughly 5% of infected individuals, involves serious complications that necessitate ventilation. [17]

In the COVID-19 outbreak, understanding both asymptomatic and symptomatic stages of infection is crucial. Asymptomatic individuals, who do not show symptoms of illness, can still carry and spread the virus. RT-PCR testing is used to detect viral nucleic acid in asymptomatic individuals, and research indicates that asymptomatic COVID-19 infections can have similar viral loads as symptomatic ones. [18, 19] So, in the event of close contact with confirmed cases, there is an increased chance of acquiring

a viral infection even in the absence of clinical symptoms. The incubation period for COVID-19, which is the time between infection and the onset of symptoms, typically ranges from 5 to 6 days. However, it can extend up to 14 days in some cases. [5] As a result, a mild or asymptomatic COVID-19 infection may unknowingly spread the virus to other individuals. However, among those who exhibit symptoms, several characteristics are associated with a worse prognosis for COVID-19 patients. So, identifying COVID-19 cases could help to reduce a complication in high-risk individuals. [20,21]

In this analysis, we systematically classified COVID-19 cases into asymptomatic and symptomatic categories, while also examining various epidemiological parameters that correlated with positive test results and the severity of illness. Our objective was to enhance our understanding of the characteristics and implications of the cases observed in our research. A study was conducted with the aim of estimating the proportion of COVID-19 cases among asymptomatic and symptomatic individuals during the COVID-19 pandemic using RT-PCR.

Material and method: -

All the samples received for COVID-19 RT-PCR testing at the Viral Research and Diagnostic Laboratory (VRDL), of the government medical college in Bhavnagar, between March 2020 to September 2023, were included in this study.

We included individuals suspected of having COVID-19 in our study according to the guidelines set forth by the Ministry of Health and Family Welfare, Government of India. [22] In these, the following individuals were included: those who had a recent history of international traveling (within 14 days); those who had travelled domestically from states with high rates of infection; those who were within the state and had signs of influenza-like illness or severe acute respiratory infections; high-risk healthcare personnel; and known contacts of confirmed COVID-19 cases. [22]

Individuals who were suspected of having a COVID-19 infection had their nasopharyngeal and/or oropharyngeal samples collected, transported into viral transport media, and sent to the VRDL testing centre along with a specimen referral form (SRF). The specimen referral form collected detailed information about each patient, including a unique identifier, collection date, sample arrival details, location (district and state), any relevant medical history, hospitalization status, potential exposure (travel, contact with positive cases, healthcare worker status), and basic demographics (name, age, gender). Upon receiving samples and specimen referral form (SRF), VRDL staff entered all information into a database using Microsoft Excel or Word. And each sample then assigned a laboratory identification number. [23]

Following the acceptance of the samples at the VRDL, each sample was subjected to RNA extraction using the conventional method in accordance with the manufacturer's instructions. Following the manufacturer's instructions, the eluted RNA was then used for the plate assay procedure after forming the master mix for the quantitative RT-PCR (qRT-PCR) test. The findings were analysed by identifying screening genes (S, E, N, and M) and confirmation genes (RdRp or ORF 1a/b). [5,21]

The testing results were entered into a data sheet using MS Office Excel. The entered data were analysed for all available details using MS Office Excel. Patient consent was obtained for sample collection, testing, and all the details regarding specimen referral form (SRF) during sample collection as per government guidelines.

Result: -

During the study period, 985160 samples were received and tested for COVID-19 by RT-PCR. Out of these samples, 2.29% (22640) tested positive, whereas the remaining were negative. Year-wise samples collections and their results are given in Table 1. These finding indicate that a greater proportion of COVID-19-positive cases was observed in 2020 (6.25%), followed by 2021 (2.46%).

Table 1: Year-wise samples collection and their COVID-19 RT-PCR test result statistics

Duration	Total number of samples tested	Positive samples	Negative samples
Year-2020	93026 (9.44%)	5820 (6.25%)	87206 (93.74%)
Year-2021	570041 (57.86%)	14068 (2.46%)	555973 (97.53%)
Year-2022	282766 (28.70%)	2650 (0.93%)	280116 (99%)
Year-2023	39327 (3.99%)	102 (0.25%)	39225 (99.74%)
Total	985160	22640 (2.29%)	962520 (97.7%)

Among all the samples, 43.7% (430561) samples from the female gender and 56.29% (554599) samples from the male gender were received during the study period. Among the 22640 RT-PCT-positive samples, 36.96% (8369) samples were received from the female gender, while 63.03% (14271) samples were received from the male gender. (Figure-1) In this study, there were greater numbers of males than females in positive cases.

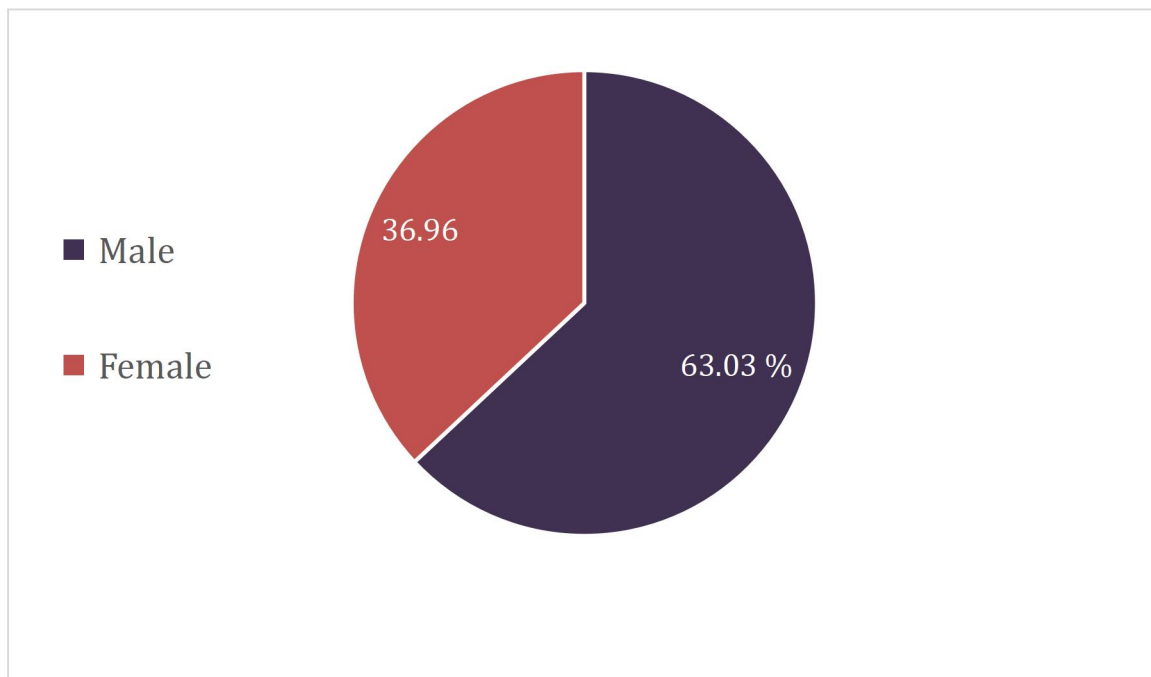


Figure-1:- Distribution of genders among COVID-19 positive cases in this study (%)

The age distribution of individuals with COVID-19 in this present study is shown in table 2 and figure 2. According to the current study, COVID-19 infection was more common in young individuals (21–40 age group).

Table 2:- Distribution of the samples according to the different age groups.

Age Group	Covid-19 RT-PCR Positive N (%)	Covid-19 RT-PCR Negative N (%)	Total Samples Numbers
<20 years	2127 (9.39%)	170776 (17.74%)	172903
21-40 years	9165 (40.4%)	474246 (49.27%)	483411
41-60 years	7704 (34.02%)	242580 (25.20%)	250284
>60 years	3644 (16.09%)	74918 (7.78%)	78562
Total	22640	962520	985160

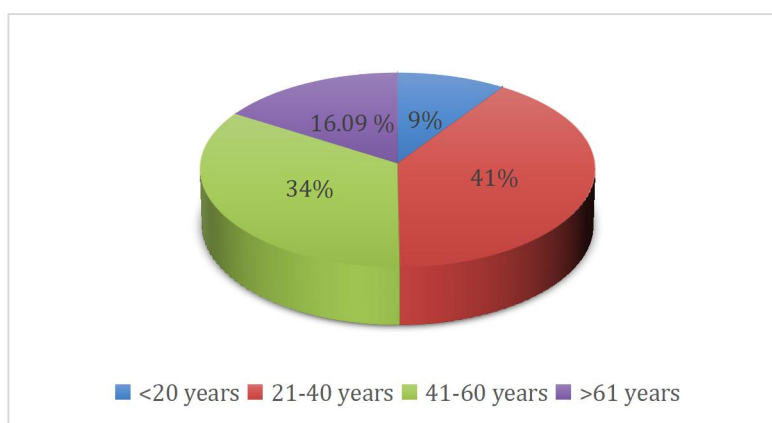


figure -2 : Covid-19 infection in various age groups

There were 22640 individuals who tested positive for COVID-19; of these, 17109 (75.56%) had no symptoms, and 5531 (24.43%) had symptoms. Of the negative cases, 42202 (4.38%) had symptoms, and 920318 (95.61%) had none.

Asymptomatic carriers were more likely to be positive in the current study than symptomatic carriers, as shown in Figure 3, which increases the possibility of COVID-19 transmission without awareness. Among individuals presenting with symptoms, 3820 (69%) had mild to moderate symptoms, while 1711 (31%) had moderate to severe symptoms.

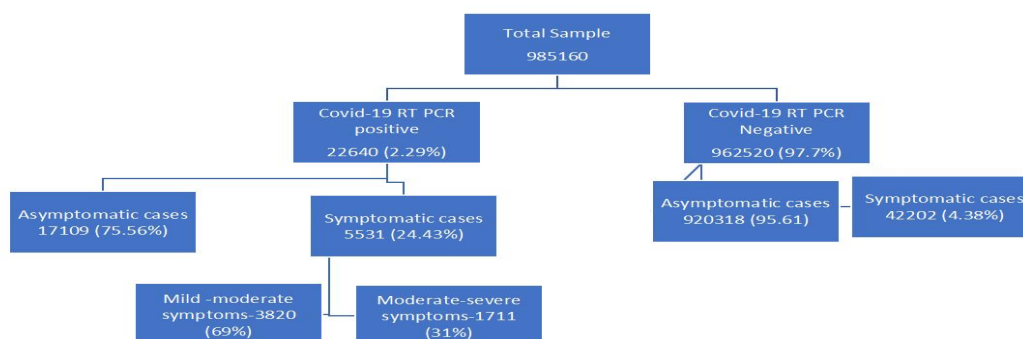


Figure 3- The proportion of positive and negative cases based on the state of symptoms.

Discussion:

In this retrospective observational analysis, we identified COVID-19 cases confirmed by RT-PCR tests based on their symptomatic status. Subsequently, we examined the sociodemographic profiles, including factors such as age and gender, among these COVID-19 individuals. The analysis showed a higher incidence of COVID-19 cases among the middle-age group, specifically among asymptomatic individuals and males.

In our study, 36.96% of females and 63.03% of males tested positive for COVID-19. That is matched with a study done by Meda S et al., which found that 62.5% of males and 37.5% of females had COVID-19 positivity. [21] However, Li, Qun, et al. reported a slightly higher percentage of female individuals (44%) compared with our study. [24]

Men and women have different biological immune systems, which may affect their ability to fight against infections like COVID-19. Men were also more likely than women to move outside their houses for work during lockdown, which could have exposed them to infections. [25] So, targeted health education, the encouragement of preventative behaviours, and an awareness of these variations in treatment and vaccination strategies are all necessary to address these disparities. [26]

In the current study, 40.40% of cases belonged to the 21–40 years age group, 34.02% were from the 41–60 years age group, and 16.09% were from the above 60 years age group, which is similar to another study by Meda S et al. in 2021, in which, 43% of the 20–40-year-old age group and 27% of the 40–60-year-old age group were affected. [21] The age group of people aged 21-60 years had the highest chances of having a COVID-19 infection. Another study conducted by Huang, Chaolin, et al., found that 34% of COVID-19-infected patients were in the 50-64 years age group, and 49% were in the 25-49 years age group. [27]

Compared to geriatric people, younger people are more likely to be in a healthier state. However, in the changed scenario, this important finding disappears due to the distorting effect of the "working status." Compared to retired individuals or those without jobs, younger populations have a higher participation rate in the workforce or income-generating activities. As a result, they face increased exposure risks during commuting and working in environments where maintaining proper social distancing might be difficult. Due to the increased public presence in workplaces, middle-aged individuals are more likely to be in contact with COVID-19 carriers on a regular basis, as well as with confirmed cases and foreign visitors. Because of this behaviour, their chances of obtaining a viral infection increase. They may come

into contact with older people and children, who are both more susceptible to this virus. This increases the chances of the virus spreading to families and communities. By understanding these behaviours, public health initiatives have focused on reducing transmission in that population by applying preventive measures. [28,29]

Within the current study, 75.56% of individuals were asymptomatic, and 24.43% were symptomatic among the COVID-19-positive cases. Among these symptomatic cases, 69% of individuals had mild to moderate symptoms like fever, coughing, and sore throats, while 31% had moderate to severe symptoms like breathlessness, chest pain, and hemoptysis. Among the COVID-19 RT-PCR-negative individuals, only 4.38% showed symptoms, while 95.61% were asymptomatic. These patterns are matched with a study conducted by Al-Qahtani M. et al. that found that 76.6% of COVID-19-positive cases were asymptomatic and 23% of the COVID-19-positive cases had symptoms. [30] similarly, a study conducted by Petersen et al., found that, 23.5% of positive cases were symptomatic, while 76.5% were asymptomatic. [31]

We found a higher percentage of asymptomatic COVID-19 individuals in the present study. Due to a number of factors that show a substantial difficulty in reducing the virus's transmission, People who are asymptomatic tend to feel healthy, and hence they are more likely to carry out daily activities like taking public transit, going to work, and attending social events. These behaviours raise the risk of spreading the infection to other people, particularly in environments where mask wearing and physical distance are less rigidly followed. [32]

More than half of new infections are caused by silent transmission (asymptomatic and pre-symptomatic spread). This phrase describes the spread of the virus among individuals who are unaware that they have been infected, which increases the difficulty of identifying and stopping outbreaks. Furthermore, asymptomatic individuals may carry a viral load that is similar to that of individuals who have symptoms. So that Similar to symptomatic patients, asymptomatic people can also retain the virus in their bodies for a long time. Because of that, the prolonged viral shed increases the risk of transmission, even though these people don't show symptoms. So, that would suggest getting medical attention or isolating themselves is important for the prevention of infection. [33] Thus, techniques to identify and mitigate the effects of these silent carriers must be part of effective control measures. When people are spreading the virus without realizing they are infected, contact tracing becomes more difficult, but it is still necessary. [34]

Conclusion: -

RT-PCR testing methods provide a number of significant benefits, including early detection, support for comprehensive surveillance, guidance for public health initiatives, and help in breaking the chain of transmission, all of which eventually help in pandemic control and public health protection. In our region, males were more affected during the COVID-19 pandemic, and the majority of them were asymptomatic. Utilizing RT-PCR for diagnosis in asymptomatic individuals can help to prevent the transmission of infection in the community. There are many asymptomatic carriers of COVID-19, and the incidence of COVID-19 among such carriers is high. Therefore, continuous surveillance, monitoring, and home isolation of asymptomatic carriers are essential for reducing transmission of infection during current and future pandemic outbreaks. Early screening and identification of a community's silent transmitters and successful implementation of evidence-based quarantine policies for individuals may help to reduce infection transmission during current and future pandemics.

Ethical aspects: -

This study was approved by the institutional Ethics Committee, Government Medical college, Bhavnagar, on 06/08/2025, under approval number EC1638/2025.

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