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Original Research Article

Household secondary attack rate of COVID 19 and its associated housing factors affecting transmission

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ABSTRACT

Background: Overcrowding and household environments are high-risk settings for transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).
Aims and Objectives: To calculate the household secondary attack rate among household contacts of confirmed case of COVID-19. 2) To elicit the housing factors affecting the transmission of infection. 3) To know the sociodemographic of the discharge patients.
Materials and Meterials: A prospective study was conducted among the COVID 19 laboratory-confirmed discharged patients admitted at District Covid Hospital, Designated Covid health centre from period May 2020 to July 2020. Total 94 patients were able to contact telephonically. Sociodemographic details were taken after informed Verbal consent. Those who are not able to contact telephonically or didn't give consent are excluded.
Results: Household secondary attack rate is 14.5%. Mean rooms per person were 2.8 with a standard deviation of 1.38. The mean age of the patients was 39 years with a standard deviation of 14.9. A mild negative correlation between the number of positive COVID-19 cases and rooms per person ($r = -0.045$, $p>0.05$) and mild negative correlation was seen with the number of family members and proportion of family members (positive COVID-19 cases in family/total members in the family) being infected by COVID-19 ($r = -0.20$, $p>0.05$).
Conclusion: Infection control and preventive strategies of household transmission such as good ventilation, isolation precautions of infected person at home, household disinfecting procedures, wearing of mask at home, hand hygiene needs to be encouraged at household level to lower the Secondary attack rate before recommendation of home isolation and home quarantine measures.

1. Introduction

SARS-CoV-2 or COVID-19 is an infectious disease caused by a coronavirus. A cluster of cases of viral pneumonia was at the World Health organization reported on 31st December 2019 in Wuhan, People's Republic of China. Majority of symptoms of coronavirus infection are Fever, Dry cough, Fatigue. Elderly above 60 years and those with any underlying medical conditions such as hypertension, cardiovascular and lung diseases, diabetes, obesity, or cancer, are at higher risk of developing serious illness.[1] The first case of the COVID-19 pandemic in India was reported on January 30, 2020. To control the transmission, the Government of India announced a nationwide lockdown on March 24th, 2020 for 21days.[2] As of January 16, 2021, the Ministry of Health and Family Welfare, Government of India has reported 211033 confirmed cases and 152093 deaths.

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Isolation and quarantine are the preventive measures implemented to contain and prevent the transmission of COVID-19. In Quarantine an exposed person is separated from others as he is exposed to a confirmed case of COVID19 infection. Quarantine is staying in the facility or at home for 14 days or twice the incubation period while Isolation is used for people with COVID-19 symptoms or who have tested positive for the virus by laboratory diagnosis, it may be a home isolation or facility isolation till the symptoms resolve or negative for COVID 19 by RTPCR test.[3]

As per WHO-China Joint Mission has stated that the majority of the human-to-human transmission of COVID-19 has been found in families.[4] Research studies also show that almost 70% of transmission of SARS-CoV-2 was attributed to contact within households when adequate community control measures were in place.[5,6] Literature shows that secondary transmission or infection of SARS-CoV-2 in household contacts ranges from 4.6% to 49.56%.[7–9]

The preventive strategies for COVID 19 are to maintain 6 feet distance or social distancing from all hygienic household measures and to isolate the confirmed case from other family members till the resolution of symptoms or laboratory-confirmed negative. Such measures such as home isolation and home quarantine measures are difficult to implement among household members or families in which no. of family members are more compared to no. of rooms available which is one of the criteria for overcrowding and favors the transmission of airborne diseases and increases the risk of getting the infection from an infected person to other household members which is also reported by WHO that WHO overcrowding or inadequate shelter are major contributors to the transmission of diseases like acute respiratory infections which can result in outbreaks or epidemic.[10]

Moreover, WHO had also published a CORRIGENDA for homecare for patients with suspected or confirmed COVID-19 and management of their contacts: interim guidance. Indicating the need for homecare in the increasing pandemic and to decrease the load on health care facilities by home isolating the mild and moderate cases of coronavirus infection.[11]

1.1. The rationale of the study

Based on the above research shreds of evidence we had to undertake the study to determine the factors affecting the household transmission among family members and also our study is aimed to estimate the household secondary attack rate of SARS-CoV-2 among confirmed COVID19 case., which may be the factors hindering the home isolation or home quarantine preventive strategies.

2. Aims and Objectives

1. To calculate the secondary attack rate among household contacts of a confirmed case of COVID19.
2. To elicit the housing factors affecting the transmission of infection for home quarantine and home isolation measures.
3. To know the sociodemographic of the discharge COVID patients.

3. Materials and Methods

3.1. Study design

A prospective study was conducted among the COVID 19 laboratory-confirmed discharged patients admitted at District Covid Hospital and adjoining Designated Covid Health centre from period.

3.2. Study period

May 2020 to July 2020.

After taking appropriate consent from district officials a list of discharge patients in the mentioned period is procured from the respective designated district COVID hospital.

3.3. Study participants and sample size

As per convenience sampling from the obtained list of COVID 19 confirmed patients admitted, randomly by lottery method 150 patients were selected, out of which 94 patients in the given period were able to contact telephonically.

1. All participants was approached telephonically by the trained medical and paramedical staff of the department. Sociodemographic details were noted in a semi-structured proforma. Participants were asked about the total members in the family as well as no. of people affected in the family and history of first person affected by COVID-19 in the family was elicited and it was taken as primary case and other affected members as secondary cases.
2. Demographic details, along with the number of rooms in their household were collected
3. Verbal consent was taken from the participant regarding his/her free will to participate in the study.

3.4. Inclusion and exclusion criteria

Those patients who had given consent was included in the study while those who are not able to contact telephonically or didn't give consent to answer the question are excluded from the study.

As the pandemic was huge and not possible to approach each and every participant for face to face interview while history case sheet was not available during the time of the interview so potential of interview bias is the limitation of the study.

3.5. Statistical analysis

The data was entered into the Microsoft Excel sheet and an appropriate statistical test was applied to meet the objective of the study.

4. Results

All the 94 primary case families that were contacted confirmed that all members of their family had been tested for COVID-19. There were a total of 465 members in 94 families of which 54 are the total secondary cases of 94 primary cases. (11.6%) were COVID-19 positive. In our study, the household secondary attack rate is estimated to be 14.5%. Out of these 94 patients, 63.8% were males and 36.1% were females (Table 1). The mean age of the patients was 39 years with a standard deviation of 14.9. The majority of patients (30.8%) belong to 31-40 years while 8.5% of patients are elderly (Table 1). Among the total 94 primary cases/families, 18 (19%) families were found of having secondary cases (Figure 1). 47 (50%) families in the present study had only 1-2 rooms in the household (Table 2). Mean rooms per person in these households were 2.8 with a standard deviation of 1.38. The mean of secondary cases per family is 3 with a standard deviation of 2.1. There was a mild negative correlation between the number of positive COVID-19 cases and rooms per person ($r = -0.045$, $p>0.05$). While a mild negative correlation was seen with the number of family members and proportion of family members (positive COVID-19 cases in family/total members in the family) being infected by COVID-19 ($r = -0.20$, $p>0.05$). (Figures 2 and 3).

Secondary Attack Rate

1. Total secondary cases = 54
2. Total household/primary case= 94
3. Total family members of primary case= 465
4. $$\frac{Total\ Secondary\ cases}{Total\ Family\ Members - Total\ Primary\ Case} X 100$$
5. 54/465-94*100= 14.5%

Table 1: Distribution of discharged patients as per age group

Age group	Male	Female	Total	Total %
0-10	1	2	3	3.1
11 to 20	2	2	4	4.2
21 to 30	14	7	21	22.3
31 to 40	19	10	29	30.8
41 to 50	11	3	14	14.8
51 to 60	09	6	15	15.9
>60	4	4	8	8.5
Total	60(63.8%)	34 (36.1%)	94	100

Table 2: Occupation wise distribution of discharged COVID 19 primary cases

Occupation	No.	%
Health Care Workers	6	6.4
Housewife	23	24.5
Company workers	47	50.0
Retired	4	4.3
Students	2	2.1
Shop owners/workers	6	6.4
Others	6	6.4
Total	94	100.0

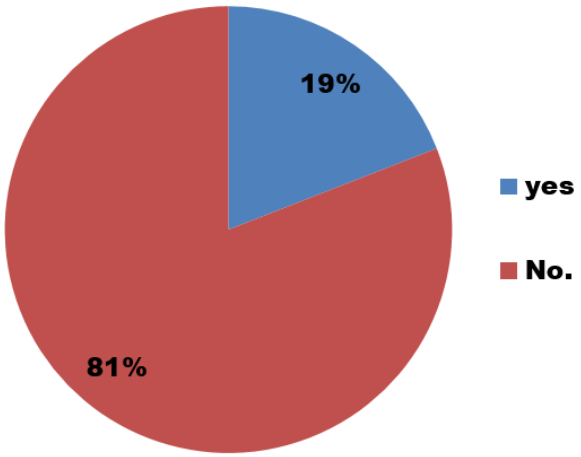

Fig. 1: Percentage of household having secondary cases in families (n=94)

Factors affecting the transmission of infection /home isolation.

Table 3: Distribution of household of as per no. of rooms

No. of rooms	No. of families
1 to 2	47 (50%)
3 to 4	38 (40.4%)
5 to 6	7 (7.4%)
more than 6	2 (2.1%)
Total	94 (100%)

50% of discharged patients (families) had only one to two rooms as it may concern for patients after discharge for home quarantine.

5. Discussion

There were a total of 456 members in these 94 families of which 54 members of 18 families (11.6%) were COVID-19 positive which is almost comparable with a study by R Laxminarayan et al. where 10.7% of infection seen among high-risk contact types.[12] Nathaniel M Lewis

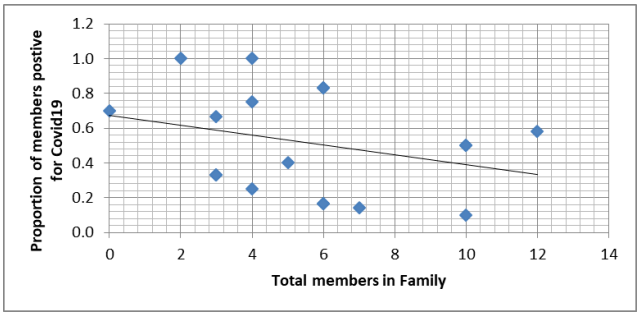

Fig. 2: Correlation between proportion of family members positive and total family members ((r=−0.20, p>0.05))

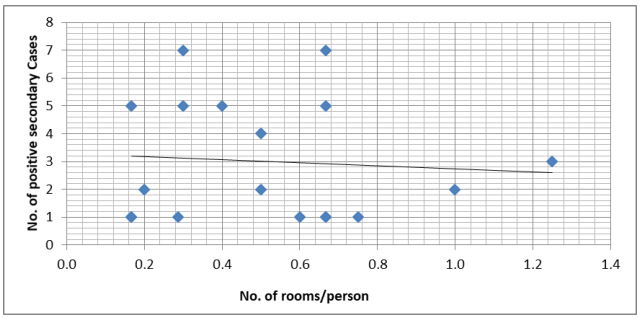

Fig. 3: Correlation between no. of rooms/person with no. of positive secondary cases (r=−0.045 p>0.05)

reported a higher prevalence of 55% of household secondary Transmission of SARS-CoV-2 among household contacts in the United States.[13] In contrast, a lower side of the prevalence of 9.3% (5.5–15.4) coronavirus infections in household members are reported in a study by Beale et al.[14] In the present study, the mean age of the patients was 39 years with a standard deviation of 14.9. The majority of discharged patients are 63.8% were males and 36% were females and a majority of patients belongs to 21-40 years age group while only 8% of discharged patients belong to >60 year age group, as the persons of this age group remain more outdoors more compared to elderly and during initial days of a pandemic it was advised for children and elderly to remain at home unless necessary. Similar findings were seen in the study by Eli S Rosenberg et al. that median age was 43 years (interquartile range: 24–56 years), and 129 (56%) were male.[15] In many other studies, it was seen that age was the most covariate, reporting lower secondary transmission of SARS-CoV-2 to child contacts than adult contacts in contrast to other studies where persons older than 60 years were most susceptible to SARS-CoV-2 infection.[16–18] In the present study the Mean of secondary cases per family is 3 with a standard deviation of 2.1 which is also reflected in another study that while most studies reported only the average number of secondary infections per index case, some also reported transmission by household. However, the transmission rates to contacts within a specific group (secondary attack rate) maybe 3-25 times lower for people who are asymptomatic than for those with symptoms.[19] In our study, we had estimated the household secondary attack rate to determine the transmissibility of SARS-CoV-2 within the household or family by dividing the number of new infections among contacts by the total number of contacts. Family contacts include the family members of index cases living in the same household as the primary case. In the present study, we found the secondary attack rate as 14.5% which is almost nearer to finding in a systematic review of Household Transmission of SARS-CoV-2A: Systematic Review and Meta-analysis by Zachary J. Madewell et al that the estimated overall household secondary attack rate was 16.6%.[20] Which is similar to a study in china by Weiwei et al. which reported The SAR among household contacts as 16.1%.[21] While a lower SAR among household contacts of 4.6% was reported in a study by Cheng H et al.[22] The overall household SAR was 37% (95% CI 31-43%) in a study by Jamie Lopez Bernal et al.[23]

In the current study, there was a mild negative correlation between the number of positive COVID-19 cases and rooms per person (r= −0.045, p>0.05). While a mild negative correlation was seen with the number of family members and proportion of family members (positive COVID-19 cases in family/total members in the family) being infected by COVID-19 (r= −0.20, p>0.05) which is suggestive of other factors like duration of contact within a household with the infected person, quarantine/isolation precautionary measures followed by the family members of the infected person, monitoring and supervision of the home isolated person and other house members by the health team, etc may be responsible for the secondary household transmission of COVID infections besides housing standards (rooms/person). Similar findings are seen by Dutta et al. on Household Transmission of COVID-19 where Mean rooms per person were 0.51± 0.20 (0.14 to 1.50) and a Mild negative correlation was seen between a number of positive COVID-19 cases and rooms per person (r= −0.138, p=0.008) while the moderate negative correlation with a number of family members and proportion of family members being COVID-19 positive (r= −0.542, p≤0.0001).[24]

In our study majority of patients (50%) are company workers as in the initial phase of pandemic there are no specific guidelines for control of infection related to the industries and 25% of infection were reported in housewife suggestive of getting an infection from other asymptomatic carriers in the household.

6. Conclusion and Recommendations of the Study

Secondary attack rate in the study was 14.5% which depends on many associated factors such as duration of contact of family members within a household with the primary case, quarantine/isolation precautionary

measures followed by the family members of primary case, monitoring and supervision of the home isolated person and other house members by the health team, etc may be responsible for the secondary household transmission of COVID infections along with housing standards (rooms/person).

Every family of the primary cases should be encouraged by the health team to adopt, infection control and preventive strategies of household transmission which includes good ventilation, isolation precautions of infected person at home, household disinfecting procedures, wearing of mask at home, hand hygiene etc., before recommendation of home isolation and home quarantine measures.

7. Strengths and Limitations of the Study

The study was undertaken during the initial period of the COVID-19 pandemic, participants are contacted telephonically and one-to-one interviews cannot be possible in the study.

8. Source of Funding

None.

9. Conflict of Interest

None.

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