



## FACTORS ASSOCIATED WITH HOUSEHOLD TRANSMISSION OF SARS-COV-2: A CROSS- SECTIONAL SURVEY ON PATIENTS DISCHARGED FROM A TERTIARY CARE HOSPITAL IN WESTERN INDIA.

**Dr. Seethal Rose\*** Resident doctor. \*Corresponding Author

**Dr. Naresh Chauhan** Assistant Professor

**Dr. Abhay Kavishvar** Associate Professor

**Dr. Shanya.G.Das** Resident doctor

**ABSTRACT** **Background:** COVID-19 disease continues to persist as a threat globally till date. Given the tremendous number of patients being affected, a solid knowledge on the transmission of SARS-CoV-2 infection with respect to host and environmental factors need to be further studied which would contribute to the existing literatures on the disease. Methods: out of the 8467 microbiologically confirmed COVID-19 cases admitted in New Civil Hospital from 15th March to 15th September 2020, a cross-sectional survey was conducted on 500 participants selected using systematic random sampling. They were telephonically interviewed after obtaining informed consent, after a mean duration of 18 months post-discharge. Out of 500 participants, 422 were patients of which 33 participants did not consent to interview and 78 were caregivers which also include those who died post-discharge (17 in number). Observations: The secondary attack rate is calculated as 3.04%. Higher odds of transmission were found in households with inadequate facilities for isolation [aOR 1.79(1.20-2.67, 95% CI)] and those with non-vulnerable occupation (non-essential worker) [aOR 2.03(1.28-3.21), 95% CI]. Asymptomatic clinical presentation of patient, [aOR 0.49 (0.26-0.92), 95% CI] and increase in age [aOR 0.96 (0.93-0.99), 95% CI] were with lesser odds of transmission of infection. Conclusions: Increased transmissibility of infection occurred in those households where facilities of isolation were not present, and where the index case was not an essential service worker, was symptomatic and belonging to less than 18 years (the children, and adolescents' groups).

**KEYWORDS :** Secondary attack rate, Household transmission of COVID-19, Risk factors for transmission, COVID-19.

### I. INTRODUCTION

The arrival of COVID-19 pandemic can be marked as a generationally unique health and global economic event in the world(1). Health organizations and governments coordinate information flow, issue directives and guidelines to best mitigate the impact of the threat. Information about the transmission mechanisms, the clinical spectrum of disease, new diagnostics, prevention, and therapeutic strategies are rapidly developing around the world(2). The aim of the study is to report the household transmission and various host and environmental factors associated with increased transmissibility of the virus.

### II. MATERIALS AND METHODS

A total of 8467 microbiologically confirmed COVID-19 patients admitted in New Civil Hospital during the first 6 months of pandemic from 15th March to 15th September 2020 were selected and from them 500 patients were selected using systematic random sampling with sampling interval as 17 starting from 15th data entry selected as a random starting number. A total of 818 patients were contacted telephonically with 450 respondents, 33 who did not give consent for interview and 17 patients who died post-discharge to obtain 500 participants. Households refers to groups of people that shared common contacts as epidemiologically linked(3). Data was entered in MS Excel and analyzed using MS Excel and SPSS version 17.

### III. OBSERVATIONS

Out of those interviewed 333 (74%) were males and the mean age was 48±10 years. The mean incubation period was 3.26 ± 2.32 days. The incubation period was calculated as the period between which the patient encountered a positive patient (exposure to agent) and the day they had appearance of first symptom.

At least 144 (32%) of the participants reported to have any history of contact with confirmed cases and 72 (16.9%) had travel history at the time of pandemic. Out of the total participants who reported movement during lock-down, about 22% of them had travelled outside of Surat city. Essential workers constituted 163 (36.2%) of study participants. Among participants, 144 (24.2%) belonged to the textile and diamond industry workers in Surat city.

When occupation of the participants was compared more transmission was reported in households of participants with occupation other than being Essential workers. Essential workers as an occupation involves

health care workers (doctors, nurses, paramedics) and front-line workers included police, ambulance drivers, volunteers, community health workers who were actively involved in the pandemic due to their work nature despite national lock-down. This group had high risk of exposure to the infection during the pandemic and vulnerable(4).

In epidemiological terms, the household Secondary Attack Rate (SAR) is defined as number of household cases occurring within the incubation period upon exposure to a primary (index) case divided by total number of susceptible/exposed household contacts. Out of the total households 49% had positive COVID cases among the exposed(5).

Secondary attack rate: Out of the 450 households with 1898 people, where testing for COVID-19 was done the total number of positive cases excluding the index cases in the household was found out to be 44 within the incubation period, in our study. The secondary attack rate is calculated as 3.04%. The index case is the patient in an outbreak who is first noticed by the health authorities, and who makes them aware that an outbreak might be emerging(6).

**Table 1: Comparison of transmissibility of infection with various host and environmental factors in participants of Cross-Sectional Survey (n=450)**

Factors		Positive n (%)	Negative n (%)	Total n	Tests of significance	p-value
Occupation (Index case)	Essential workers	62(38.0)	101(62.0)	163	Chi-Square $\chi^2=12.04$	0.00
	Others	158(55.10)	129(44.9)	287		
	Total	220(48.9)	230(51.10)	450		
Overcrowding	Present	99(47.4)	110(52.6)	209	Chi-Square $\chi^2=0.36$	0.30

P<0.05-significant

\*Positive group were household with at-least one contact of the infected patient, who came out to be positive and negative group includes those household which did not report any positive patient despite contact with infected patients. Transmissibility was inferred to be more in these positive group among households.

Environmental factors like facilities for isolation determined by availability of separate bathroom and room had association with transmissibility, as lesser positive cases were reported in those with such facilities available compared to those without them. Overcrowding did not have any association with transmissibility among the study participants (Table 1).

Clinically asymptomatic cases had less chance of transmission compared to symptomatic cases. More than 50 % of clinically symptomatic cases had reported positive cases among those exposed. As high as 70 % of participants belonging to children and adolescent age group had positive cases reported among those exposed indicating more transmissibility from this group. Host factors like sex also did not have any association although females had more transmitted case compared to males.

Also appropriate tests of significance were applied to look for association between other socio-economic factors like education of the patients (Fisher's Exact test value=3.83, p=0.8), Socio- economic status (Chi-Square test  $\chi^2=6.69$ , p=0.1) and area of residence (Fisher's Exact test value=0.42, p=0.3) with transmission of illness within the family/household and they were found to be without any statistical significance (p>0.05).

To ascertain the effects of various host and environmental factors like age of index case, clinical presentation of index case, vulnerable occupation of index case, absence of facilities for isolation on the likelihood of having positive cases among the exposed, and indirectly the transmissibility, a binary logistic regression was performed. The model was statistically significant,  $\chi^2=27.47$ , p=0.00 and correctly classified 65 % of cases (Table 2).

**Table 2: Predictors for transmissibility of infection within the households of infected patients in participants of Cross-Sectional Survey using Binary Logistic Regression.**

Factors	B	S.E.	aOR	95% CI	p
Age (index case)	-0.035	0.016	0.96	(0.93-0.99)	0.03
Absence of facilities for isolation	0.583	0.205	1.79	(1.20-2.67)	0.00
Asymptomatic clinical presentation of patient (index case)	-0.696	0.314	0.49	(0.26-0.92)	0.02
Non-essential worker (index case)	0.711	0.234	2.03	(1.28-3.21)	0.00

P<0.05-significant, aOR- adjusted odds ratio

As age increases there is lesser odds of transmission and therefore children and adolescents have more probability to transmit the virus in the exposed group compared to adults. Asymptomatic patients had lesser odds to transmit the virus compared to symptomatic cases in the exposed group. Absence of facilities for isolation had an aOR of 1.79 (1.20-2.67) at 95 % CI to transmission compared to the other group in the exposed group. People belonging to non-essential workers had 2 times odds of transmission compared to HCW and FLWS in the exposed group.

#### IV. DISCUSSION

Transmissibility of the infection among exposed households and various host and environmental factors related to spread of infection were assessed. Significant proportion of cases were reported from households of non-essential workers. Increased awareness, greater understanding of preventive aspects and better knowledge about the spread of the virus among the essential workers could be the reason behind this observation.

Infectivity is the ability of the agent to establish the infection in a host

and transmissibility is the ability of the agent factor to transmit from one host to another(8). Transmissibility is used here as the clinical profile of contacts are not known. Environmental factors like facilities for isolation determined are important because of the infectious nature of the disease. As per our study symptomatic cases and children had more potential to transmit the infection to their contacts compared to asymptomatic cases and adults. This result was comparable with a study done among household contacts of COVID patients(3).

The household secondary attack rate was calculated to be 3.04 in our study. In a systematic review of 13 articles done around the world including India from December 2019 to June 15th, 2020, the SAR varied from 4.6% to 49.56%. The household contacts included in this review were defined as individuals sharing the same living address with the positive cases, which was the same criteria followed in our study(9). In India a study conducted under ICMR initiative between 22nd January 2020 to 30th April 2020 on 1,021,518 individuals showed that the SAR was 6% (5.4 – 8.1%, 95% CI)(10). This study was done on all symptomatic and asymptomatic groups (high-risk contacts or high-risk healthcare workers). There is a difference in the SAR between this study and the ICMR study owing to the possibility that this study had a different time-period and the ICMR study reported community transmission and not household transmission rate. Additionally there may be chances of recall bias at the time when telephonic interview was done.

It is essential to focus on household transmission because it contributed to the steep escalation in COVID-19 cases, even after extreme social-distancing norms and national lockdowns around the world (9). Nearly half of the households in our study has reported transmission of virus in the house-hold contacts. Though self-health awareness and awareness created through social media could bring the patients to health care facilities, it may be notable that the transmission to contacts occurred in almost half of the households. It may be because the preventive measures to spread were not sufficiently/effectively followed in these households and that may have resulted in the spread of infection within.

#### V. CONCLUSION

Increased transmission occurred in those households where facilities of isolation were not present, and where the index case was not an essential service worker, was symptomatic and belonged to children and adolescent age groups. Therefore, those clinically diagnosed symptomatic cases and those who are of young age should focus more on preventive measures like hand hygiene, judicious use of mask and follow proper isolation procedures. Household transmission, if curtailed could provide key input in changing the trajectory of disease like COVID -19. The higher rate of transmissibility in children and younger adults should be focused particularly on schools and colleges especially in an event of outbreak. More behavioural, environmental, and genetic factors related to both host and agent factors needed to be assessed further for interaction.

#### VI. REFERENCES

- Pascarella G, Strumia A, Piliago C, Bruno F, Del Buono R, Costa F, et al. COVID-19 diagnosis and management: a comprehensive review. Vol. 288, Journal of Internal Medicine. 2020.
- Napoli. MCMRACSCDR Di. Features, Evaluation, and Treatment of Coronavirus - StatPearls - NCBI Bookshelf [Internet]. [cited 2020 Oct 12]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK554776/>
- Li F, Li YY, Liu MJ, Fang LQ, Dean NE, Wong GWK, et al. Household transmission of SARS-CoV-2 and risk factors for susceptibility and infectivity in Wuhan: a retrospective observational study. Lancet Infect Dis [Internet]. 2021;21(5):617–28. Available from: [http://dx.doi.org/10.1016/S1473-3099\(20\)30981-6](http://dx.doi.org/10.1016/S1473-3099(20)30981-6)
- Erratum: Occupation and risk of severe COVID-19: Prospective cohort study of 120 075 UK Biobank participants (Occupational and Environmental Medicine (2021) 78 (307-314) DOI: 10.1136/oemed-2020-106731). Occup Environ Med. 2022 Feb 1;79(2).
- Shah K, Saxena D, Mavalankar D. Secondary attack rate of COVID-19 in household contacts: a systematic review. QJM [Internet]. 2020 Dec 1 [cited 2022 Aug 24];113(12):841–50. Available from: <https://pubmed.ncbi.nlm.nih.gov/32726452/>
- Giasecke J. Primary and index cases. Lancet [Internet]. 2014 Dec 6 [cited 2023 Apr 22];384(9959):2024. Available from: <http://www.thelancet.com/article/S014067361462311X/fulltext>
- Mongiú-Tortajada M, Bayes-Genis A, Rosell A, Roura S. Are mesenchymal stem cells and derived extracellular vesicles valuable to halt the COVID-19 inflammatory cascade? Current evidence and future perspectives. Thorax [Internet]. 2021 Feb 1 [cited 2022 Dec 13];76(2):196–200. Available from: <https://thorax.bmj.com/content/76/2/196>
- The Textile & Diamond Industry of Surat is Responsible for the Livelihood of Many ... - Latest Tweet by PIB India [Internet]. [cited 2022 Dec 11]. Available from: <https://www.latestly.com/socially/india/news/the-textile-diamond-industry-of-surat-is-responsible-for-the-livelihood-of-many-latest-tweet-by-pib-india-4264659.html>
- Shah K, Saxena D. Article Type: Systematic review Title: Secondary Attack Rate of COVID-19 in household contacts: Systematic review. 2020; Available from: <https://mc.manuscriptcentral.com/qjm>
- Abraham P, Aggarwal N, Babu GR, Barani S, Bhargava B, Bhatnagar T, et al. Laboratory surveillance for SARS-CoV-2 in India: Performance of testing & descriptive epidemiology of detected COVID-19, January 22 - April 30, 2020. Indian J Med Res

