SSRG International Journal of Medical Science
ISSN: 2393 – 9117 /doi:10.14445/23939117/IJMS-V8I5P103

Volume 8 Issue 5, 6-9, May, 2021

Secondary Attack Rate of Severe Acute Respiratory Syndrome Coronavirus-2 Infection From Adults To Children Due To Household Transmission; A Cohort Study

Adarsh E[#1], Surabhi[#2], Shilpa R[#3]

Head of the department[#1], Senior Resident[#2] and Junior Resident[#3], Department of Pediatrics, Rajarajeswari Medical College and Hospital, Bangalore-74, Karnataka, India

1821/87, Vinayaka Nagar, Saraswathi Layout, Opposite to Samveda special children school, Davanagere-577004

Received Date: 22 April 2021
Revised Date: 29 May 2021
Accepted Date: 31 May 2021

Abstract – *In the midway of the pandemic, understanding transmission dynamics for SARS CoV-2 infection is important to stop the chain of transmission; chances of spread of infection is increased at household setting owing to the duration of contact with an infected person, high viral load, and various sociodemographic factors, so early case identification and separation of close contacts help in the prevention of the spread of infection.*

Keywords — *COVID 19 – Coronavirus disease 2019, RT PCR- real tine reverse transcription-polymerase chain reaction, SAR- Secondary attack rate, SARS-CoV-2 - Severe acute respiratory syndrome coronavirus-2, SES- Socioeconomic status.*

INTRODUCTION

The COVID-19 pandemic is caused by SARS-CoV-2. The first case was identified in Wuhan, China, in January 2020 and has now been reported worldwide in 214 countries and territories[1]. Although clinically presents with minor illness, it may account for severe illness or even death in elder individuals and those with chronic diseases. Based on many studies conducted so far, it's observed that the children usually present with minor illnesses and have a good outcome.

Coronavirus infection accounts for 10 - 30% of cases of the common cold every year. Human coronavirus shows the peak in the winter months, low temperature, and dry air currents impair and disrupt the integrity of the epithelial layer of the lungs, which might explain the winter seasonality of all respiratory viruses.[2] The most frequent symptoms in children are fever, cough, anosmia, gastrointestinal symptoms, sore throat/pharyngitis, difficulty breathing, myalgia, rhinorrhea /nasal congestion, and headache.

In spite of raising cases, studies on epidemic features are scarce and little knowledge about the transmission and infectivity in the household. The secondary attack rate is a good measure of the person-to-person spread of infection after being introduced into a population.

NEED FOR THE STUDY

Due to the present situation, it was decided to study the SAR by contact tracing with considering the effect of Sociodemographic features like Socioeconomic status, literacy rate, residency, the relationship of an index case with the child, and outcome of the index case on the SAR.

OBJECTIVES

To analyze secondary attack rate from adults to children in household settings, with consideration of variables like contact type, symptom status, number of adult/child contact, contact gender, relationship to the index case, the outcome of the index case, and outcome of the child.

DATA COLLECTION

Data collected by a structured questionnaire including epidemiological, demographic, and clinical information of the primary case.

ETHICS STATEMENT

Institute ethical committee approval was taken for the study, and we also obtained verbal informed consent from subjects before the start of the interview.

METHODS

A hospital-based retrospective cross-sectional study was conducted at Rajarajeswari medical college and hospital pediatrics department from 1st July 2020 to 20th October 2020. This hospital is a specialized COVID-19 hospital with 150 pediatrics beds.

All children aged between 1 to 18 years with positive RT PCR for SARS CoV-2 infection from nasopharyngeal swab are included in the study. All cases were assessed initially in the Emergency Department of the hospital; following admission to the ward, detailed clinical and family history of the child is taken from parents or the attender in person or over a telephonic conversation.

Asymptomatic or children with mild symptoms were discharged on 10 days of onset of symptom and afebrile 3 days prior to discharge with instruction for strict home isolation of child for 2 weeks.

The study was approved by the institutional ethics review board. Informed oral consent was taken in light of the need to notify public health outbreak control policies.

For study purposes, we defined the primary case as the first person who's positive for SARS CoV-2 infection in a household setting.

RESULTS

Total 113 children admitted to our center during the study period were enrolled in the study in which 90 children had a history of the primary contact at the household settings, 10 children were the primary cases themselves, and in the remaining 13 children, source of infection was unidentifiable, with age distribution from 1month to 18 years, predominant age group affected was between 1-5 years (25.7%) and 11-15 years (27.4%).

Out of 113 subjects, 65 were male (57.5%), and 48 subjects were female (42.5%), with an increased percentage of male subjects in the study.

Based on the residency of the study population, 62 (54.9%) subjects out of 113 reside in an urban area and 51 (45.1%) from a rural area, shows that majority cases are from urban area

Most of the subjects in the study belong to the Lower middle class (48.7%), Upper middle class (41.6%), least number of cases seen in the Upper class of SES

Out of 113 children's in the study, parents of 103(91.2%) children were literates, and parents of 10 children were illiterate

Based on the level of education in parents of children, number of educated fathers were slightly higher compared to mother, most predominant education levels in both parents being Undergraduate, 10th class, 2nd year PUC, ITI and Diploma

On taking the detailed clinical history of the index case at the household settings, it was observed that Father was the index case in 50.4% of the subjects compared to others.

In this study, the total number of children enrolled for the study is 113, and with detailed history, on the household SARS CoV-2 positive cases, it was observed that the total number of Infected members (Father/Mother/Grand Parents/Other Adults) is 144 Excluding *Siblings*

= 144 people among 113 Families

The recovery rate in the study was 97.9% in total, and the death of 3 index cases seen

In the study, it's observed that the father was the most common index case compared to other family members. Based on the residency, it was observed that the urban population is more involved than the rural.

Table I: Bi-variate Analysis of Source and Residency

Transmission Source	Urban		Rural	
	N	%	N	%
Father	33	53.2	24	47.1
Mother	2	3.2	5	9.8
Grand Parents	9	14.5	7	13.7
Other Adults	5	8.1	5	9.8
Neighbor's	7	11.3	3	5.9
Untraceable	6	9.7	7	13.7
Total	62		51	

Fig I: Bi-variate Analysis of Source and Residency

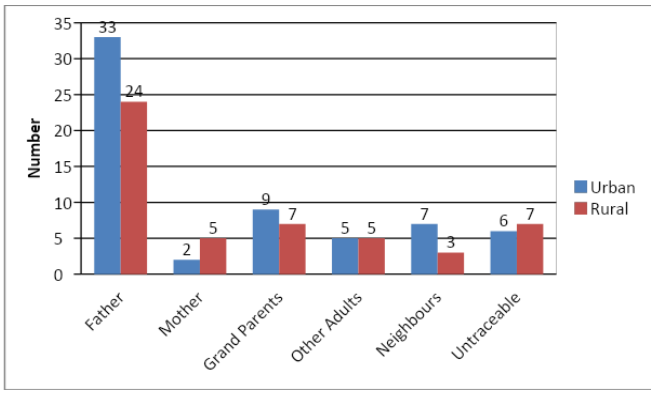
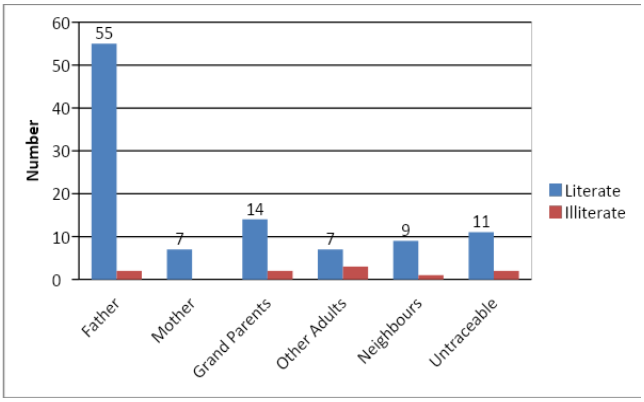


Table II: Bi-variate Analysis of Source and Education status

Parents Education Status	Literate		Illiterate	
Transmission Source	**N**	**%**	**N**	**%**
Father	55	53.4	2	20
Mother	7	6.8	0	0
Grand Parents	14	13.6	2	20
Other Adults	7	6.8	3	30
Neighbor's	9	8.7	1	10
Untraceable	11	10.7	2	20
Total	103		10	

Fig II: Bi-variate Analysis of Source and Education status



It was observed that 68.1% of cases in the study had no history of COVID-19 infection in other children at the household level, and 30.1% of cases had one or more SARS CoV-2, positive children, at the house.

51.3% of children in the study were Asymptomatic, and 48.7% were symptomatic; common presenting symptoms are Fever, Cough, running nose, and loose stools and recovery rate is observed to be 100%

It is observed that 25.9% of symptomatic children in the study also had a history of one or more SARS CoV-2 positive children in the household level, 74.1% symptomatic children had no history of another pediatric household contact.

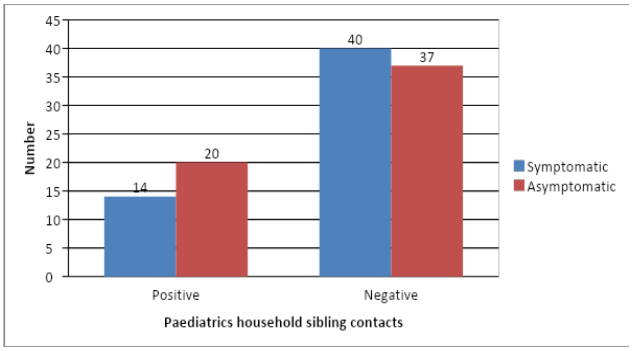
35.1% of Asymptomatic children also had a history of another pediatric contact in the house, 64.9% of asymptomatic children had no history of another pediatric household contact.

Table III: Bi-variate Analysis of Symptomatic and Pediatric contact

Pediatric Symptoms Status	Pediatrics household contacts				
	Positive		**Negative**		**Total**
	N	**%**	**N**	**%**	**N**
Symptomatic	14	25.9	40	74.1	54
Asymptomatic	20	35.1	37	64.9	57
Total	34	30.6	77	69.4	111

Chi-square statistic = 1.0954. The p-value is 0.295. Not significant at $p < 0.05$

Fig III: Bi-variate Analysis of Symptomatic and Pediatric contact



In our study of 113 subjects, it was seen that father was the most common index case and accounted for 50.4% of the secondary attack rate, 44.65% is the overall secondary attack rate which was observed in our study.

Secondary attack rate calculated excluding self and neighbors in our study

=100-13-10

=90

90 households in the study had a primary case in a family.

Total Number of positive cases (both children and parents) =146

Total number of people in 90 household = 417

Secondary attack rate = (146/417-90) x 100%

=44.65%

The recovery rate in the study was 97.9% in total, and death of 3 index cases seen among the family members, no adverse outcome seen among children during the study period.

DISCUSSION

The study confirms that the secondary attack rate was high among children who were in contact with SARS CoV-2 positive adult at the household setting, and this information can be used for formulating preventative guidelines for families to decrease the transmission in an area where there is a high risk of community transmission of COVID-19. [3]

Stay-at-home orders implemented in response to the pandemic reduced human mobility by 45% - 60% in India,35–63% in the USA,7 63% in the UK,8 and 54% in Wuhan relative to normal conditions. This concomitantly increased time spent at home and likely increased household transmission of SARS-CoV-2. [4]

Based on many studies, household transmissions are considered the major factor of epidemic growth.

Children most probably contract the infection in their household or through contact with infected family member's, particularly in countries where school closures and strict physical distancing has been implemented. [2]

In a publication from Italy, exposure to SARS CoV-2 from an unknown source or from a source outside the child's family accounted for 55% of the cases of infection, while in another Italian cohort, contact with a SARS CoV-2 infected person outside the family was rarely reported and 67.3% (113/168) of children had at least one parent who tested positive for SARS CoV-2 infection. [2]

CONCLUSIONS

This study showed a secondary transmission rate of 44.65% for SARS CoV-2, which is higher than SARS CoV and MERS CoV. The study also shows that the highest risk of transmission is seen with the father as primary case compared to other household members, so timely detection and quarantine of confirmed/ suspected/ close contact case is urgently required to prevent COVID-19 from a wider spread in the community.

So, preventive measures implemented in pre-symptomatic or early symptomatic period for SARS CoV-2 infection is effective to the driver of epidemic growth, and this can flatten the curve.

Despite its importance, data on attack rates from detailed analysis of household transmission in children remain scarce

Further studies are required with a larger sample size and in multiple centers for a better understanding of COVID-19 infection transmission dynamics.

ACKNOWLEDGMENT

The authors would like to thank all faculty working in our department for the general supervision and valuable suggestion for proofreading the article.

Funding: No funding sources

Conflicts of interest: None declared

Ethical approval: Institutional ethical committee approval taken

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