



## ASSESSING COVID-19 IN UTTARAKHAND: A SERO-EPIDEMIOLOGICAL COMMUNITY SURVEY

|                              |                                                                                                                                                                                  |
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### INTRODUCTION:

During the Covid-19 pandemic, India was one of the worst hit countries in the world. A wide variation was observed in the reporting of cases across the States/Union Territories and across the districts within each State in the country. However, a majority of the SARS-CoV-2 infected patients remained asymptomatic, and undiscovered<sup>1</sup>. Despite the global number of infections reaching tens of millions during its peak, the overall infection rate was relatively low within the local infection hotspots<sup>2</sup>. The seroprevalence of antibodies was thus important to understand the transmission intricacies of the virus such as, estimating total infections, including mild and asymptomatic individuals who might not have tested<sup>3</sup>; and the possibility of transmission interruption through the depletion of susceptible individuals if seroconversion was associated with robust immunity. Facility-based surveillance efforts, although were found to be useful were not representative of the population especially in hilly areas, as that of Uttarakhand. Population-based sero-epidemiological studies were therefore, recommended to measure the extent of spread of infection in a given area<sup>4</sup>. We thus aimed to measure serum levels of SARS-CoV-2 antibodies in the population of hilly areas and to assess the association with SARS-CoV-2 antibody titers with ABO blood groups.

### METHODS:

The study was conducted in mid-hills (Pauri- Garhwal) and foothills (Dehradun) of Uttarakhand, India. Selection of these two districts was done purposively according to the distribution of Covid-19 cases in State. The blocks selected from Dehradun district were Raipur and Kalsi; and the blocks selected from Pauri-Garhwal district were Duggadha and Jaharikhal. To obtain the objectives according to the distribution of the population among the target area, Probability-proportional-to-size (PPS) sampling was used to collect samples in the ratio of 1:3 (i.e., 200 samples from Pauri-Garhwal district, consisting of 100 individuals who were COVID infected and 100 individuals as controls; and 600 samples from Dehradun district, consisting of 300 individuals who were COVID infected and 300 individuals as controls). Two blocks from each district were selected on the basis of highest and lowest prevalence of Covid-19 cases. The data was collected by visiting each household from the selected blocks of the two districts. Blood sample was collected under aseptic conditions and well labelled for easy identification of the participant. The serum levels of IgG antibodies were measured by standard selected methods using

IgG based Enzyme-Linked Immunosorbent Assay and Chemi Luminescent Immuno Assay assays<sup>5</sup>, as approved by Indian Council of Medical Research and United States Food and Drug Administration. Ethical approval for this study was obtained from the Swami Rama Himalayan University (SRHU/HIMS/E-1/2021/37). Written informed consent was obtained from each participant.

The statistical analysis was performed using SPSS version 22. One-sample Kolmogorov-Smirnov Test was employed to determine whether the data sets differ from the normal distribution or not. Categorical variables were expressed in terms of frequency and percentage. Quantitative variables were expressed by using descriptive statistics. A p-value < 0.05 was considered as statistically significant.

### RESULTS:

A total of 800 study subjects participated in the study from both the districts of state from July 2022 to December 2022. In brief, a large majority of participants in both Dehradun and Pauri districts had high levels of IgG antibodies, indicating widespread exposure to COVID-19 virus. Despite variations in blood group distribution, no statistical link was found between blood type and antibody response. Most participants were in the 20-40 age range, highlighting the impact on younger populations. (Supplementary Table 1)

### DEHRADUN DISTRICT:

The data suggests that a high proportion of participants in Dehradun district had developed strong IgG antibodies against COVID-19, regardless of age group or blood group. While B+ and O+ were more common blood types, there was no evidence that these groups were more likely to have higher antibody levels.

- High Antibody Titters and Blood Group Distribution: Majority of the people had B+ blood group (32.7% participants), followed by A+ (26.7%), O+ (19.3%) and 14.7% AB+ (19.3%) blood groups. IgG antibody titre of > 85 was taken as strongly positive. 92.7% of the total participants were strongly positive, followed by 5% participants who were moderately positive (IgG antibody titre level ranging between 18-85). There were 2.3% of the total participants who had antibody titre level below 18 interpreted as negative. The comparison is better given in the table below.
- No Significant Association: There was no statistically significant

association between blood group and antibody titer level in either block. (Table 1)

**Table 1: Association Between Blood Group And Antibody Titre In Different Areas**

| Blood Group | Raipur             |         |           | Kalsi              |         |           | Dugadda            |         |           | Jaiharikhal        |         |           |
|-------------|--------------------|---------|-----------|--------------------|---------|-----------|--------------------|---------|-----------|--------------------|---------|-----------|
|             | IgG Antibody Titre |         |           | IgG Antibody Titre |         |           | IgG Antibody Titre |         |           | IgG Antibody Titre |         |           |
|             | <18                | 18-85   | >85       | <18                | 18-85   | >85       | <18                | 18-85   | >85       | <18                | 18-85   | >85       |
| A+          | 2(0.7%)            | 4(1.3%) | 74(24.7%) | 1(0.3%)            | 8(2.7%) | 62(20.7%) | 0(0.0%)            | 2(2.0%) | 26(26.0%) | 0(0.0%)            | 0(0.0%) | 37(37.0%) |
| A-          | 0(0.0%)            | 1(0.3%) | 8(2.7%)   | 0(0%)              | 0(0%)   | 9(3.0%)   | 0(0.0%)            | 0(0.0%) | 2(2.0%)   | 0(0.0%)            | 0(0.0%) | 0(0.0%)   |
| B+          | 3(1.0%)            | 4(1.3%) | 91(30.3%) | 4(1.3%)            | 6(2.0%) | 72(24.0%) | 1(1.0%)            | 0(0.0%) | 34(34.0%) | 2(2.0%)            | 1(1.0%) | 18(18.0%) |
| B-          | 0(0.0%)            | 0(0.0%) | 6(2.0%)   | 1(0.3%)            | 2(0.7%) | 7(2.3%)   | 0(0.0%)            | 0(0.0%) | 1(1.0%)   | 0(0.0%)            | 1(1.0%) | 3(3.0%)   |
| AB+         | 0(0.0%)            | 1(0.3%) | 43(14.3%) | 3(1.0%)            | 4(1.3%) | 29(9.7%)  | 0(0.0%)            | 0(0.0%) | 9(9.0%)   | 1(1.0%)            | 0(0.0%) | 13(13.0%) |
| AB-         | 0(0.0%)            | 1(0.3%) | 2(0.7%)   | 0(0%)              | 1(0.3%) | 1(0.3%)   | 0(0.0%)            | 0(0.0%) | 0(0.0%)   | 0(0.0%)            | 0(0.0%) | 0(0.0%)   |
| O+          | 2(0.7%)            | 4(1.3%) | 52(17.3%) | 2(0.7%)            | 8(2.7%) | 76(25.3%) | 0(0.0%)            | 3(3.0%) | 21(21.0%) | 0(0.0%)            | 2(2.0%) | 20(20.0%) |
| O-          | 0(0.0%)            | 0(0.0%) | 2(0.7%)   | 0(0%)              | 0(0%)   | 4(1.3%)   | 0(0.0%)            | 0(0.0%) | 1(1.0%)   | 0(0.0%)            | 0(0.0%) | 2(2.0)    |
| p-value     | 0.66*              |         |           | 0.42*              |         |           | 0.44*              |         |           | 0.085*             |         |           |

**Supplementary Table 1: Socio-demography characteristics of the study subjects**

| Characteristics      |            | Raipur(N=300) | Kalsi (N=300) | Dugadda(N=100) | Jaiharikhal(N=100) |
|----------------------|------------|---------------|---------------|----------------|--------------------|
|                      |            | Frequency (%) | Frequency (%) | Frequency (%)  | Frequency (%)      |
| Age Group (years)    | < 20       | 3(1.0%)       | 37(12.3%)     | 24(24%)        | 7(7.0%)            |
|                      | 20-40      | 101(33.7%)    | 176(58.7%)    | 41(41%)        | 48(48.0%)          |
|                      | >40-60     | 153(51.0%)    | 71(23.7%)     | 30(30%)        | 30(38.0%)          |
|                      | >60        | 43(14.3%)     | 16(5.3%)      | 5(5%)          | 7(7.0%)            |
| Gender               | Male       | 141(47%)      | 124(41.3%)    | 93(93%)        | 58(58%)            |
|                      | Female     | 159(53%)      | 176(58.7%)    | 7(7%)          | 42(42%)            |
| Marital Status       | Married    | 264(88%)      | 239(79.7%)    | 58(58%)        | 84(84%)            |
|                      | Unmarried  | 36(12%)       | 61(20.3%)     | 42(42%)        | 16(16%)            |
| No of family Members | <4         | 54(18%)       | 16(5.3%)      | 12(12%)        | 10(10%)            |
|                      | >4         | 246(82%)      | 284(94.7%)    | 88(88%)        | 90(90%)            |
| Nutritional status   | Good       | 298(99.3%)    | 19(6.3%)      | 100(100%)      | 1(1%)              |
|                      | Average    | 2(0.7%)       | 281(93.7%)    | 0(0%)          | 99(99%)            |
| Occupation           | Student    | 27(9%)        | 56(18.7%)     | 38(38%)        | 13(13%)            |
|                      | Employed   | 58(19.3%)     | 63(21%)       | 44(44%)        | 50(50%)            |
|                      | Unemployed | 175(58.3%)    | 181(60.3%)    | 15(15%)        | 37(37%)            |
|                      | Business   | 38(12.7%)     | 0(0%)         | 2(2%)          | 0(0%)              |
|                      | Other      | 2(0.07%)      | 0(0%)         | 1(1%)          | 0(0%)              |

#### PAURIDISTRICT:

The data suggests that a high proportion of participants in Pauri district had developed strong IgG antibodies against COVID-19, regardless of age, gender, or blood group. While A+ and B+ were more common blood types, there was no evidence that these groups were more likely to have higher antibody levels.

- High Antibody Titters and Blood Group Distribution: More than 90% of the participants were found to be strongly positive followed by 5% participants with moderately positive antibody titre level. Only 1% of the participants had the antibody titre level below 18 i.e., negative. Majority of the study participants had B +ve blood group (35%) followed by A +ve (28%), O +ve (24%), AB +ve (9%) and the A -ve (2%) blood group.
- No Significant Association: There was no statistically significant association between blood group and antibody titer level in either block. (Table 1)

There was a high SARS-COV antibody titre amongst the population from both high and low pandemic areas of district Dehradun and district Pauri. Such high immune response overtime may be due to gradual introduction of Covid -19 vaccine and circulation of virus after second wave of Covid.

The study finds its uniqueness in being the first study to assess SARS-CoV-2 antibodies in the hilly areas of Pauri and Dehradun district. However, limited resources, geographic dispersion and cultural differences posed a challenge in engaging with local communities and obtaining informed consent. The study also faced difficulty in collecting accurate and reliable data due to factors like language barriers, limited digital infrastructure thus enabling potential biases in data collection methods.

#### FUTURE CONSIDERATIONS:

**1. FACTORS INFLUENCING ANTIBODY PREVALENCE:** Explore factors beyond blood group, such as previous COVID-19 infections, vaccination status, socioeconomic conditions, and healthcare access.

**2. LONG-TERM ANTIBODY PERSISTENCE:** Investigate the duration of IgG antibody persistence and its correlation with

protection against reinfection.

**3. VARIANT-SPECIFIC RESPONSES:** Study the impact of different COVID-19 variants on antibody responses and immune protection.

**4. COMMUNITY-LEVEL FACTORS:** Analyse factors at the community level, such as population density, mobility patterns, and healthcare infrastructure, that might influence disease spread and antibody prevalence, in the hilly areas.

**5. VACCINATION IMPACT:** Evaluate the effectiveness of COVID-19 vaccines in inducing and maintaining antibody responses in different populations.

#### CONCLUSION

The study provides first-hand information into the prevalence of IgG antibodies and its associated factors in Uttarakhand. While the findings highlight the widespread exposure to COVID-19, further research is needed to understand the complex interplay between various factors influencing antibody responses and long-term immunity.

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