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The influence of relative humidity on rhinovirus infectivity in aerosol phase

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The recent Covid-19 pandemic has renewed interest in studying the impact of environmental factors on airborne transmission of viral infectious diseases. Human rhinovirus is the main reason of acute respiratory infections primarily driven by young children who average 6–10 infections annually, while healthy adults typically experience 2–3 infections per year. Although airborne transmission is the most likely route for rhinovirus to spread, there is currently a lack of research on this topic. This study investigates the infectivity of aerosolized rhinovirus in particles <15 µm at 10%, 30%, and 90% RH

Rhinovirus was aerosolized using a BioAerosol Nebulizing Generator (BANG, CH Technolgies) into a one-meter flow tube, where it was mixed with particle free air of a chosen RH. Samples were collected after 8 seconds in aerosol phase into liquid media using the BioSpot operating at 12 L/min (*Aerosol Devices*). Particle size distributions were characterized by an Aerodynamic Particle Sizer (*APS, Model 3321, TSI Inc*.) and a Scanning Mobility Particle Sizer (*SMPS, TSI Inc*.), while RH and CO_2 levels were monitored with a LI-COR gas analyzer (*LI-840 A, Biosciences)*. Virus genome quantities and infectivity were analyzed via quantitative polymerase chain reaction (qPCR) and the cell infection assay, respectively. Finally, MPN results were normalized using viral gene concentration and total collected aerosol mass based on the APS and SMPS measurements.

When infectivity was normalized to viral RNA copies, the highest infectivity was observed at 10% RH (6×10^{-5} MPN/copy number), followed by 90% RH (1.41×10^{-5} MPN/copy number), and lowest at 30% RH (8.44×10^{-6} MPN/copy number). Normalization to the mass of collected aerosol revealed a similar pattern, which was expected, as we predict virus genomes to be evenly distributed in the aerosol and correlate with aerosol mass. Kruskal-Wallis analysis indicated no statistically significant difference across RH levels ($p > 0.05$). Within each RH group, across a total of 12 runs, aerosol concentration showed up to 8% run-to-run variation from the group mean. More repeats are needed to establish differences.

With the setup in this study, we can experimentally assess how short-term exposure to different relative humidity (RH) levels affects rhinovirus infectivity in aerosols phase. While additional experiments are needed to draw firm conclusions, the results of this study can provide crucial data for developing more effective protective measures against the airborne spread of viral diseases, particularly the common cold.