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Mathematical Analysis of Coronavirus Disease (Covid-19)

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Abstract: Provide a short summary of the coronavirus disease (COVID-19), its global impact, scientific findings, and importance of continued research and preparedness. Also analysed COVID -19 effected on children, adults and senior citizens, particularly found people with age above 30 years effected more than people below 30 years age.

Keywords: *COVID-19; SARS-CoV-2; Pandemic; Variants; Vaccination; Epidemiology; Treatment; Public Health.*

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I. INTRODUCTION

Overview of SARS-CoV-2 and the disease it causes. Importance of studying COVID-19: public health, economic, and social implications. The Coronavirus disease (COVID-19) is an infectious disease caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). It was first identified in December 2019 in the city of Wuhan, Hubei province, China. The outbreak quickly spread across the globe, leading the World Health Organization (WHO) to declare it a Public Health Emergency of International Concern (PHEIC) on January 30, 2020, and later a pandemic on March 11, 2020.

Belongs to the Coronaviridae family of viruses. SARS-CoV-2 is an RNA virus, with a spike-shaped protein that allows it to attach to and enter human cells via the ACE2 receptor. It is primarily a respiratory pathogen, but it also affects multiple organs.

➢ *COVID-19 Spreads Mainly Through:*

Respiratory droplets from coughing, sneezing or talking. Close contact with infected persons. Surface transmission (touching contaminated surfaces and then touching face, eyes, mouth, or nose). Airborne transmission in poorly ventilated or crowded places. Common symptoms include:

- Fever
- Dry cough
- Fatigue
- Shortness of breath
- Loss of taste or smell (anosmia) Severe cases may lead to:

✓ Pneumonia
✓ Acute Respiratory Distress Syndrome (ARDS)
✓ Multi-organ failure
✓ Death

- Health Impact: Millions of infections and deaths worldwide.
- Economic Impact: Severe global recession, disruptions in trade, travel restrictions, unemployment.
- Social Impact: Lockdowns, school closures, remote work, psychological stress.
- Personal Measures: Wearing masks, maintaining social distancing, frequent handwashing, using sanitizers.
- Medical Measures: Testing, contact tracing, isolation, and treatment.
- Vaccination: Development of multiple vaccines (Pfizer, Moderna, Covishield, Covaxin, etc.) provided a major breakthrough. Proper documentation of Coronavirus is crucial for:
- Healthcare professionals: To record cases, symptoms, and treatment outcomes.
- Researchers: For studying mutations, vaccine effectiveness, and long-term effects.
- Governments and Policy Makers: For planning public health strategies and resource allocation.
- General Public: To increase awareness and promote preventive behavior.

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II. SCOPE OF THIS DOCUMENTATION

Coronavirus Disease 2019 (COVID-19) is an infectious respiratory illness caused by the novel coronavirus SARS-CoV-2. After its emergence in late 2019, it spread globally and caused multiple waves driven by changes in behavior, seasonality, and viral evolution. Transmission occurs mainly via respiratory aerosols at close range in indoor settings with poor ventilation. Disease severity ranges from asymptomatic to critical illness, with higher risk among older adults, immunocompromised individuals, and those with chronic comorbidities. Control strategies combine vaccination, antivirals for high-risk patients, and layered non-pharmaceutical interventions (e.g., ventilation, masking when risk is high, isolation during the infectious period).

- Mathematical Data & Assumptions Epidemiological models: SIR/SEIR models to represent spread.
- Basic reproduction number (R_0): Estimated between 2–3 for early strains; higher for variants like Delta/Omicron.
- Assumptions: Homogeneous mixing of population. Constant transmission probability per contact. Immunity and waning immunity considered in later models.
- Data sources: WHO, CDC, MoHFW India, Our World in Data.

III. RESULTS

Global cases and mortality trends (insert data/tables). Vaccine coverage statistics (global and India-specific). Impact of interventions (lockdowns, mask mandates, vaccination campaigns). Key findings: reduced severity with vaccines, emergence of immune-escape variants.

➢ *Figures:*

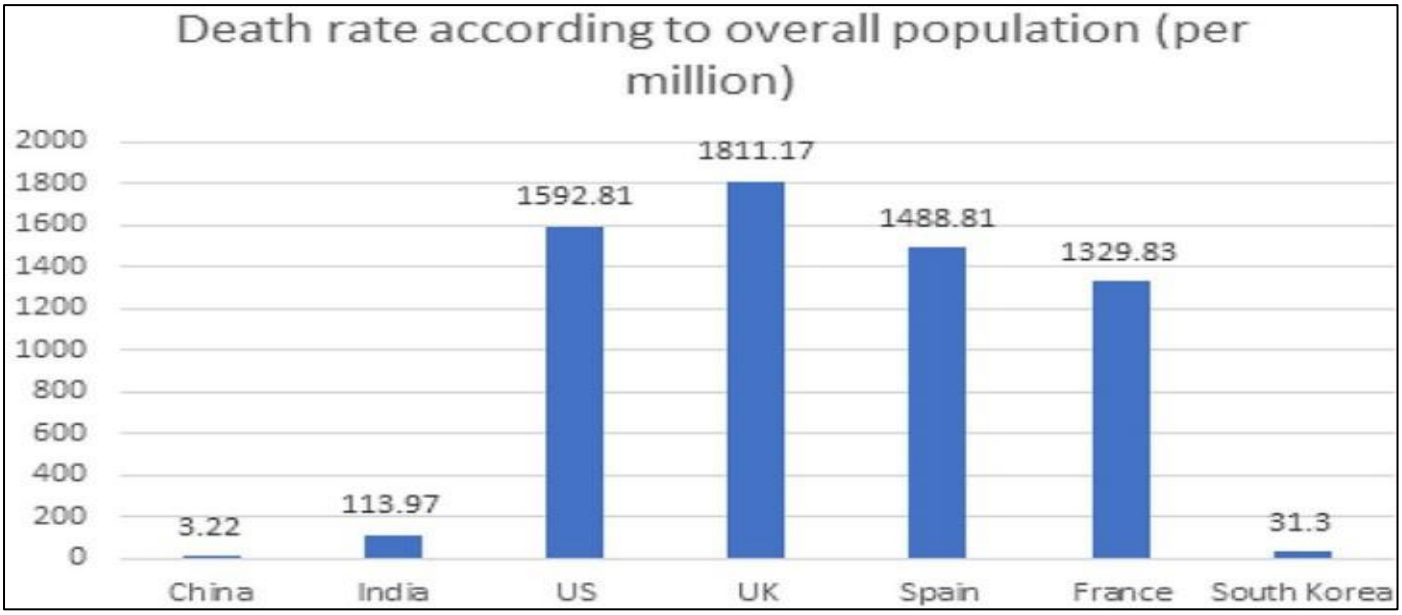

Fig 1 Proportion of Vaccinated vs Unvaccinated Population (India-Specific).

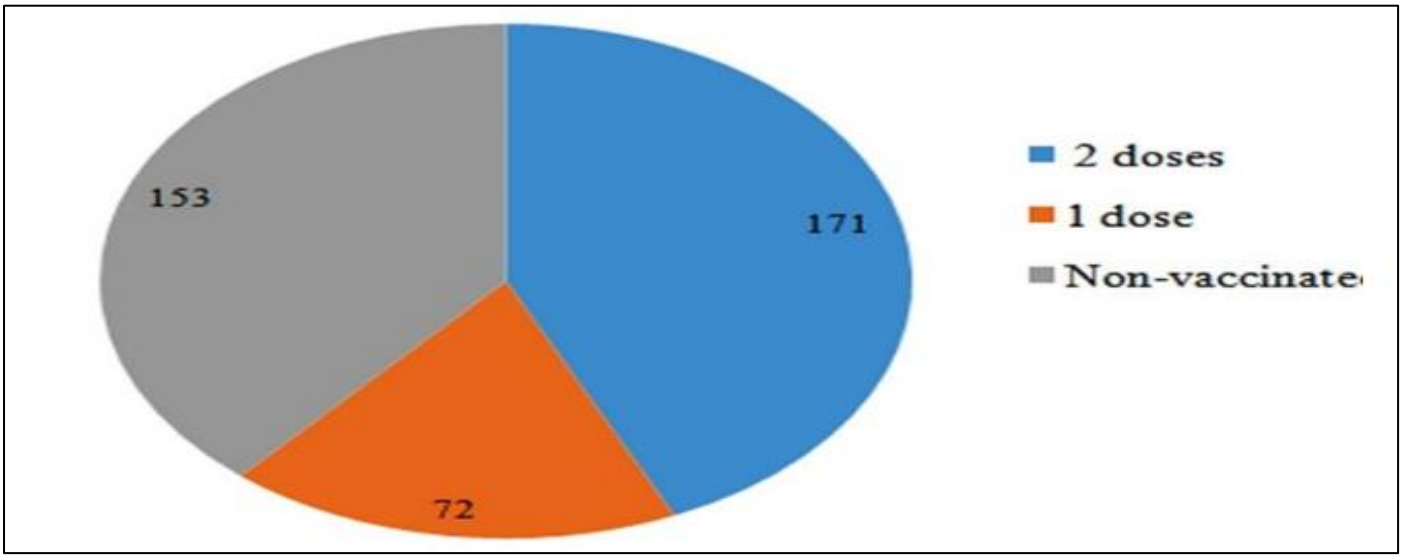

Fig 2 2 Dose 1 Dose Non-Vaccinate

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IV. DISCUSSION

Implications of results on healthcare systems and policies. Strengths and weaknesses of control measures. Comparison of global vs India-specific outcomes. Future outlook: need for updated vaccines, improved ventilation, and Long COVID research. Public health implications. Layered risk controls (ventilation, air filtration, timely testing/isolation, and targeted masking) can materially decrease β\betaβ. Vaccination reduces both susceptibility and severe outcomes, indirectly lowering effective transmission by reducing infectious duration in treated/immune individuals.

V. MODEL LIMITATIONS

The SEIR framework here omits age structure, waning immunity, reinfections, seasonality, variant evolution, healthcare capacity constraints, and behavior changes over time. Real-world estimates require calibrated parameters from surveillance, serology, and (if available) wastewater data. Results should therefore be interpreted qualitatively.

FUTURE WORK

Extend to SEIRS with waning immunity, add vaccine/antiviral compartments, include age/setting structure (households, schools, workplaces), and fit parameters to observed data using Bayesian inference. Explore indoor air quality impacts by explicitly modeling ventilation (ACH) and occupancy.

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REFERENCES

[1]. World Health Organization (WHO). Coronavirus disease (COVID-19) dashboard. https://covid19.who.int/ Accessed [DD Month YYYY].
[2]. Ministry of Health and Family Welfare (MoHFW), Government of India. COVID-19 Updates. https://www.mohfw.gov.in/ Accessed [DD Month YYYY].
[3]. Our World in Data. COVID-19 data explorer. https://ourworldindata.org/coronavirus Accessed [DD Month YYYY].
[4]. World Health Organization. Coronavirus disease (COVID-19): Overview. [Add access date].
[5]. Centers for Disease Control and Prevention (CDC). COVID-19 Science and Research. [Add access date].
[6]. Our World in Data. Coronavirus Pandemic (COVID-19). [Add access date].
[7]. Keeling MJ, Rohani P. *Modeling Infectious Diseases in Humans and Animals*. Princeton University Press; 2007.
[8]. Hethcote HW. The Mathematics of Infectious Diseases. *SIAM Review*. 2000;42(4):599–653.