

A close-up photograph of a healthcare worker wearing white gloves and a watch, administering a vaccine to a baby. The baby is being held by a woman in a pink sari. The healthcare worker is holding a small vial and a syringe, and the baby is looking up at the worker. The background is slightly blurred, showing a clinical setting.

# Evaluating the Protective Impact of Rotavirus Vaccination on Childhood Diarrhea in India: Insights from the National Family Health Survey

(Investigating the Rotavirus Vaccine's Role in Improving Child Health Outcomes)

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# Diarrheal Disease: A Significant Global and National Public Health Threat

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## Key Points:

- ❖ Diarrheal disease is a leading cause of morbidity and mortality in children under five, especially in developing nations.
- ❖ Rotavirus is the most frequent cause of severe acute watery diarrhea in young children worldwide and is the leading cause of the estimated 500000 annual child deaths due to diarrhea globally.
- ❖ India's Burden: Diarrheal diseases are the second leading cause of death in children under five in India, accounting for over 300000 deaths annually.
- ❖ The most frequent cause of severe acute gastroenteritis (AGE)/acute watery diarrhea in young children worldwide is rotavirus.
- ❖ In 2013, rotavirus gastroenteritis was estimated to cause over 78000 pediatric deaths per year in India.

# The Intervention: Rotavirus Vaccine

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## Rotavirus Vaccine: A Highly Effective Public Health Intervention

- ❖ The rotavirus vaccine is considered the most effective public health intervention for reducing rotavirus diarrhea, hospitalizations, and deaths.
- ❖ The indigenous monovalent Rotavirus Vaccine (Rota Vac) was introduced into India's Universal Immunization Program (UIP) in 2016.
- ❖ It was gradually introduced nationwide, reaching PAN India by 2019.
- ❖ The introduction of the vaccine was projected to prevent approximately 27,000 deaths, 220,000 hospitalizations, and 3.4 million outpatient visits due to diarrhea annually in India.

# India's Rotavirus Vaccination Journey

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**2015-2016**

Two indigenous vaccines (ROTAVAC, ROTASIIL) licensed by Drug Controller General of India

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**2016**

Rotavirus vaccine introduced in Universal Immunization Program - 4 states initially

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**2018**

WHO prequalification obtained for both Indian vaccines

4

**2019**

Pan-India rollout completed across all states and union territories

# Trend of diarrheal prevalence in India

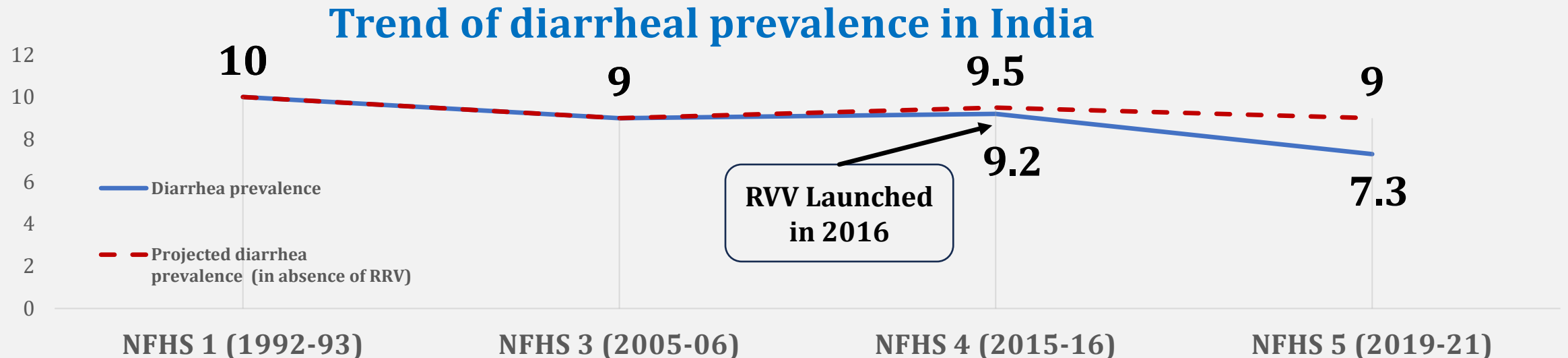


**1992–93 (NFHS-1):** Diarrhea prevalence was **10%**.

**2015–16 (NFHS-4):** After two decades, the prevalence had only slightly decreased to 9.2%.

**2016:** The Rotavirus Vaccination was introduced into India's Universal Immunization Program.

**2019–21 (NFHS-5):** A significant reduction was observed, with prevalence dropping to 7.3%.



This analysis suggests a strong correlation between the introduction of the rotavirus vaccine and the substantial decrease in diarrheal prevalence among Indian children.

# Study Design and Data Source

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## National Family Health Survey 2019–21 (NFHS-5):

The fifth round of the NFHS provides national, state, and district-level health indicators. Its focus is on fertility, mortality, and maternal/child health in India.

### Sampling and Population:

- **Design:** Stratified Two-Stage Sampling (PPS for PSUs, systematic random household sampling).
- **Sample Size:** Data from over 724,000 women and 101,000 men. Focus Population: Children aged 12–35 months.

### Key Variables:

- **Outcome:** Diarrhea (any episode in the two weeks preceding the survey).
- **Key Explanatory Variable (Treatment):** Rotavirus Vaccination (RVV) status (number of doses received).
- **Covariates:** A wide range of socioeconomic factors (education, wealth index, religion, residence, etc.).

# Statistical Analysis and Causal Inference

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## Primary Analytical Goals:

- Describe the distribution of RVV doses and diarrhea prevalence by socioeconomic status.
- Estimate the causal impact of RVV on diarrheal disease.

## Statistical Methods:

- **Descriptive/Distribution:** Used STATA's svyset command to account for survey design and estimate distributions with 95% CIs.
- **Association:** Multivariate Logistic Regression to explore the effect of RVV and socioeconomic factors on diarrhea.
- **Software:** STATA version 16.

## Causal Impact Estimation:

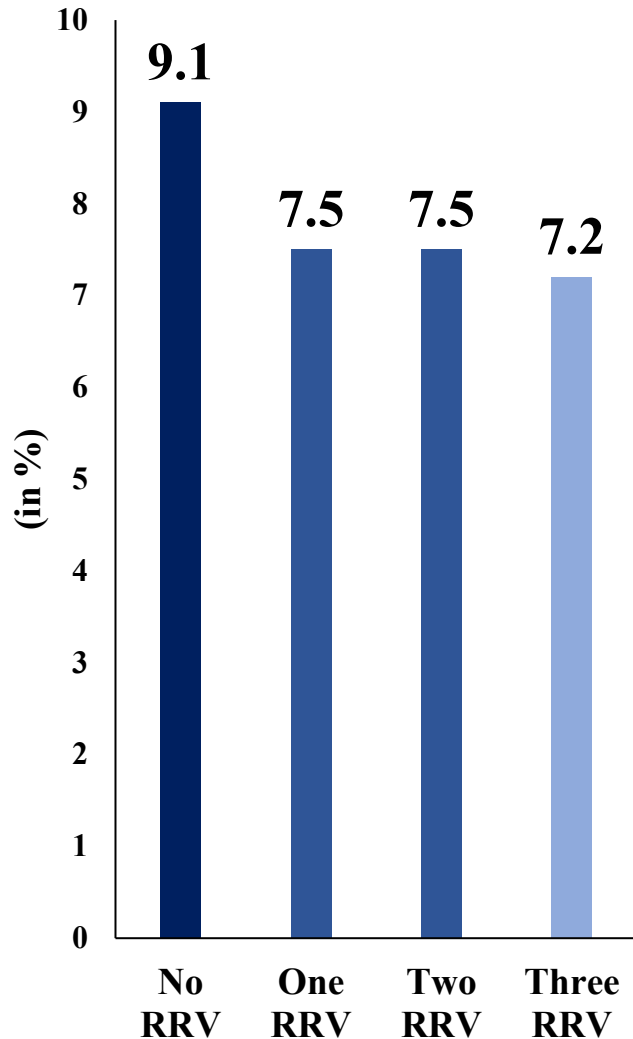
- **Method:** Propensity Score Matching (PSM), used to balance observed covariates (X) between the treated (RVV received) and untreated groups.

$$p(\mathbf{X}) = \Pr(\mathbf{D} = 1 | \mathbf{X}) = E(\mathbf{D} | \mathbf{X})$$

# Key Finding 1: Diarrhea Prevalence Trend



Prevalence of Diarrhea among children 12-35 months in India, 2015-16 and 2019-21



## Diarrhea Trend in India:

NFHS-4 (2015-16, pre-national introduction): **9.2% prevalence.**  
NFHS-5 (2019-21, post-national introduction): **7.3% prevalence.**  
This represents a **20.6%** reduction in diarrhea prevalence between the two survey rounds.

## Treatment of Diarrhea:

24.9 percent of children received antibiotics (NFHS-4)

21.1 percent of children received antibiotics (NFHS-5)

## Bivariate Analysis (Children 12-35 months):

Overall Diarrhea Prevalence: **8.3%.**

Prevalence among children who did NOT receive Rotavirus Vaccine: **9.1%.**

Prevalence among children who received all three doses of Rotavirus Vaccine: **7.2%.**

## Key Finding 2: Logistic Regression Results

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### Multivariate Logistic Regression Result:

Children who received all three doses of the rotavirus vaccine were 16% less likely to experience diarrhea compared to those who did not receive any rotavirus vaccine (Odds Ratio: 0.84; 95% CI: 0.79-0.89)

### Other Protective Factors (Decreased Diarrhea Risk):

- Children in the richest wealth quintile (26% less likely than the poorest).
- Children whose mothers' age at birth was 30+ years (31% less likely than teenage mothers).
- Children whose mothers received health and nutrition education during post-natal care.
- Children with normal birth weight ( $\geq 2.5$  kg).

# Key Finding 3: Propensity Score Matching

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(Causal Effect)

## Average Treatment Effect on the Treated (ATT) - Overall:

Propensity-score kernel matching showed that children (12-35 months) who received the Rotavirus vaccine had a 1.7% lower risk of diarrhea compared to a matched hypothetical scenario where they did not receive the vaccine.

## ATT by Subpopulation:

- Children aged 12-23 months who were vaccinated had a **2.3%** less risk of diarrhea.
- Vaccinated children from the poorest households had a **3.1%** lower chance of diarrhea.
- Vaccinated children with mothers who had no schooling had a **3.0%** lower risk of diarrhea.

# Multiple Factors Contributing to Diarrhea Reduction



**Rotavirus Vaccine Efficacy:** The effectiveness of the rotavirus vaccine is lower in low-income countries due to factors such as unsafe water, poor nutrition, and inadequate sanitation.

**India's Progress:** Significant improvement in the recent decade in areas that reduce diarrheal prevalence, including:

- Safe drinking water (Jal Jeevan Misson).
- Nutrition (Poshan Abhiyan).
- Sanitation (Swachh Bharat Misson).
- Intensified Diarrhea Control Fortnight (IDCF) promoting ORS and zinc use.

# Discussion & Policy Implications

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## Key Discussion Points:

- The findings are consistent with studies in other countries showing reduced rotavirus infections after vaccine introduction.
- Preventing diarrheal disease also leads to reduced healthcare costs, allowing families to save more for essential needs like education and food.

## Policy Recommendations:

The study results can inform policy decisions and help healthcare professionals focus efforts on reducing the diarrheal disease burden.

Incorporate the rotavirus vaccine in calculating Full Immunization Coverage (FIC) to better monitor effectiveness and improve coverage.

Policymakers must ensure sustained political and financial commitment to maintain high vaccine coverage.

# Limitations

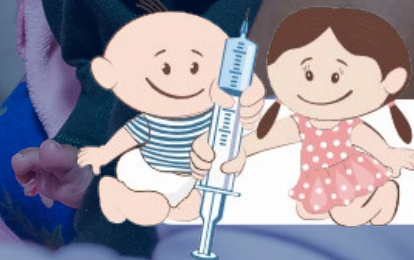
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- **Data Lack Specificity:** The cross-sectional survey data only captured the presence of diarrheal disease in the last two weeks.
- **Viral Cause Unknown:** The survey did not specify the type of virus causing the diarrhea (e.g., Rotavirus, Norovirus, Enteric Adenovirus, etc.).
- **Cannot Isolate Vaccine Effect:** It is impossible to determine if the observed reduction is due only to the Rotavirus vaccine or if other factors/viruses were impacted.
- **Impact on Attributable Reduction:** This lack of viral specificity limits our ability to fully attribute the reduction of diarrheal prevalence to the rotavirus vaccine.



**Thank you**



**Be Wise!**

**Get your child  
fully immunized**