Impact of Rotavirus Vaccine on Malnutrition among Children: Evidence from National Family Health Survey (NFHS) 2019-2021, India

Ajeet Kumar Singh [1], Pawan Kumar[2], Pritu Dhalaria[1], Sanjay Kapur [3], Pretty Priyadarshini[1], Ajay Kumar Verma[1], Arindam Ray[4], Bhupendra Tripathi[4]

1Immunization Technical Support Unit-Ministry of Health & Family Welfare, GoI; 2Immunization Division, MOHFW, GoI; 3John Snow India; 4Gates Foundation, India

Background

- **Stunting, Wasting, & Underweight** – Three key indicators measuring nutritional balance–a triple threat of malnutrition
- Stunting–33% (204 million) to 22% (148 million); wasting–8.7% to 6.8% (45 million) from 2000 to 2022 (Unicef, 2023)
- **Bidirectional relationship between diarrhea and malnutrition**
- Malnutrition – both a cause and consequence; diarrhea accounts for approximately 10% of under 5 deaths in India
- **2016: Rotavirus vaccine (RVV) introduced in India's Universal Immunization Program**
- 2019: Nation-wide rollout; administered at 6, 10, & 14 weeks; data captured in NFHS-5 (2019-21)

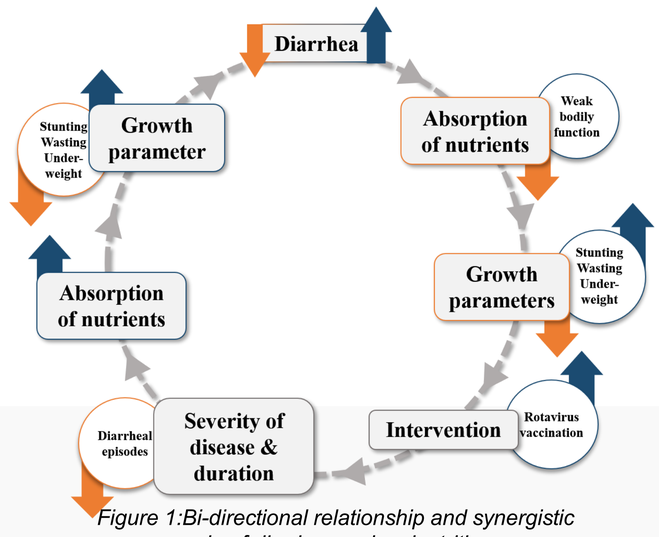
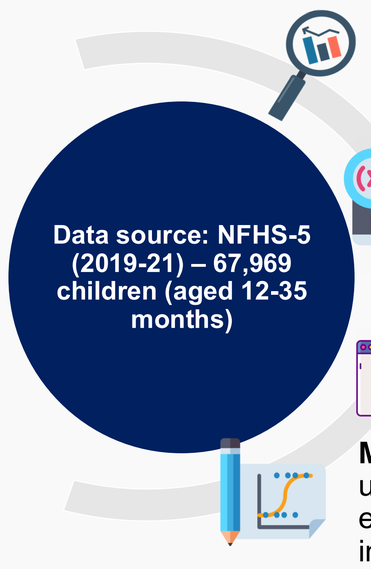


Figure 1:Bi-directional relationship and synergistic cycle of diarrhea and malnutrition.

Methods

Hypotheses: RVV reduces the risk of rotavirus-induced diarrhea, infectious diseases, and nutrient malabsorption, thereby contributing to improved anthropometric outcomes, such as height-for-age, weight-for-age, and weight-for-height metrics in vaccinated children compared to those who are unvaccinated.

Objective: The study aims to explore the relationship between RVV and the indicators of malnutrition–stunting, wasting, & underweight



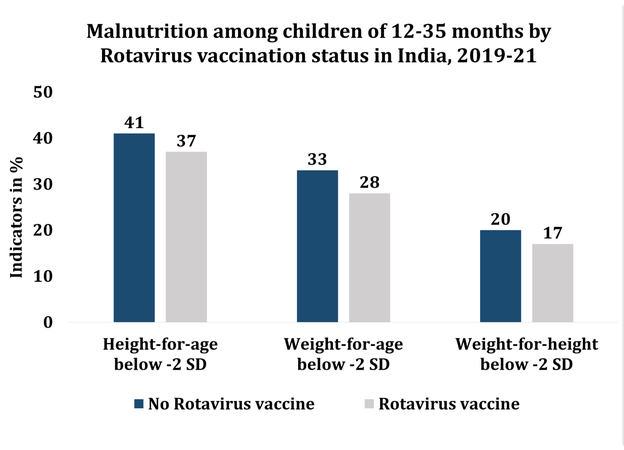
Software: STATA 19.5

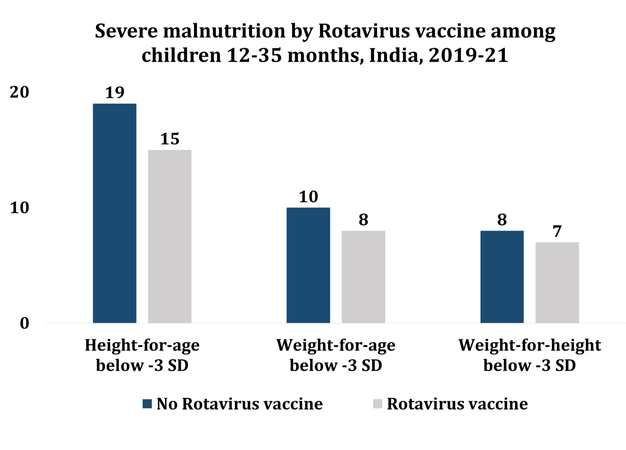
Exposure Variables: Rotavirus vaccination status; Sociodemographic variables (child's age, sex, birth order, maternal education level, maternal boy mass index (BMI), religion, place of residence, social group, place of delivery (home/institutional), wealth quintile, toilet facilities)

Outcome Variable: Wasting, stunting, and underweight among children aged 12-35 months

Methodology: bivariate analysis between RVV and stunting, wasting, and underweight in children aged 12-35 months; six multivariate regressions employed on anthropometric measures and RVV and IPWRA for causal inference

Findings





Outcome variables	No RVV (aOR)	1 or 2 doses of RVV (aOR)	3 doses of RVV (aOR)
Height-for-age below -2 SD	1	0.94	0.88***
Weight-for-age below -2 SD	1	0.91**	0.86***
Weight-for-height below -2 SD	1	0.89**	0.85***
Height-for-age below -3 SD	1	0.99	0.86***
Weight-for-age below -3 SD	1	1.02	0.85***
Weight-for-height below -3 SD	1	0.95	0.82***
Inference: Children who received all three doses of rotavirus vaccines demonstrated a significant reduction in the odds of severe malnutrition across all three outcomes.			

*Table 1: Association between RVV and undernutrition, Significance: *P < 0.05; **P < 0.01; ***P < 0.001*

Outcome variables	Treatment Variable	Description of treatment	ATT Coeffi. (95% CI)	ATE Coeffi. (95% CI)
Model-I				
Height-for-age below -2 SD	RRV	Any VS Zero dose	-0.026***	-0.027***
Weight-for-age below -2 SD	RRV	Any VS Zero dose	-0.028***	-0.028***
Weight-for-height below -2 SD	RRV	Any VS (Zero dose)	-0.023***	-0.021***
Model-II				
Height-for-age below -2 SD	RRV	All (3) VS Zero dose	-0.029***	-0.029***
Weight-for-age below -2 SD	RRV	All (3) VS Zero dose	-0.03***	-0.03***
Weight-for-height below -2 SD	RRV	All (3) VS Zero dose	-0.026***	-0.023***

*Table 3; Inverse-probability-weighted regression adjustment (IPWRA) estimates of average treatment effect and average treatment effect on the treated. , Significance: *P < 0.05; **P < 0.01; ***P < 0.001*

Socio-demographic variables; (lowest order of variable with OR 1)	Highest order of variable	Height for age below -2 SD/-3 SD (aOR)	Weight for age below -2 SD/-3 SD (aOR)	Weight for height below -2 SD/-3 SD (aOR)	Interpretation	
Birth order (1[R])	4 or more birth order	1.47***/ 1.40***	1.40***/ 1.48***	0.99/0.96	*Higher birth order* associated with *poor anthropometric measures*	**Children from urban areas: higher risk of becoming malnourished compared to those living in rural areas** **Maternal education and BMI: significant impact on child malnutrition** **Child's wealth status: strongly associated with nutritional status**
Maternal education (No schooling[R])	≥11 years complete	0.67***/ 0.57***	0.72***/ 0.63***	0.86***/ 0.85**	Higher education acts as a '*protective factor*'	
Place of delivery (Institutional birth[R])	Non-institutional	1.17***/ 1.17***	1.11***/ 1.23***	1.00/1.01	*Non-institutional deliveries* associated with *poor anthropometric measures*	
Maternal BMI (<18.5 kg/m^2)[R]	BMI 18.5 to 24.9 kg/m^2	0.73/0.80	0.61/0.65	0.79/0.92	Normal maternal BMI acts as a *'protective factor'*	
Wealth quintile (poorest[R])	Richest	0.54***/ 0.53	0.48***/ 0.47	0.73***/ 0.86	*Higher socioeconomic status* associated with *better anthropometric measures*	
Toilet facility (improved[R])	Unimproved	1.09***/ 1.03	1.09***/ 1.10**	1.04/1.04	*Compromised WASH is a risk factor* for malnutrition	
*Note: Significance: *P < 0.05; **P < 0.01; ***P < 0.001*						

Table 2: Association between Rotavirus vaccine and Undernutrition among children

Recommendations

1. **Full 3-dose coverage is critical**; Unvaccinated and partially vaccinated children are at greater risk of diarrhea and malnutrition.
2. **Integrated maternal-child health strategies**—high impact of maternal influence
3. **Integration of immunization with nutrition and WASH** interventions for a synergistic impact
4. Calls for **deeper exploration of healthcare access and living conditions** in urban areas – equity lens (urban slums, peri-urban areas)
5. Data-driven insights inform **vaccine impact evaluations** and **strengthen advocacy for sustained vaccination programs.**

Presenter Contact: Ajeet Kumar Singh(ajeet.singh@jsi.org)