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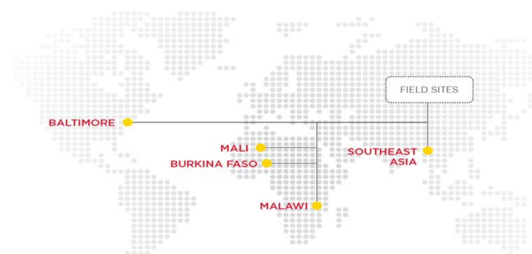

University of Maryland School of Medicine
Center for Vaccine Development and Global Health

Change in risk factors for diarrhea mortality across a 10-year period between Global Enteric Multicenter Study (GEMS) and Vaccine Impact on Diarrhea in Africa (VIDA)

Emily Deichsel[1], Helen Powell[1], Adama Mamby Keita[2], M Jahangir Hossain[3], Richard Omore[4], Doh Sanogo[2], Samba O. Sow[2], Joquina Chiquita M. Jones[3], Dilruba Nasrin[1], Jennifer Verani[5], Marc-Alain Widdowson[5], Milagritos Tapia[1], Karen L. Kotloff[1]

[1]Center for Vaccine Development and Global Health, University of Maryland School of Medicine, Baltimore, Maryland, United States of America; [2]Centre pour le Développement des Vaccins du Mali (CVD-Mali), Bamako, Mali; [3]Medical Research Council Unit The Gambia at London School of Hygiene and Tropical Medicine, Banjul, The Gambia; [4]Kenya Medical Research Institute/Center for Global Health Research (KEMRI-CGHR), Kisumu, Kenya; [5]Division of Global Health Protection, Kenya Office of the US Centers for Disease Control and Prevention, Nairobi, Kenya

Vaccine Impact on Diarrhea in Africa

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Background

- Diarrhea related mortality has decreased in recent decades as countries improve social, economical, and environmental conditions.[1]
- However, diarrhea remains a leading cause of mortality among children under 5, causing nearly 500,000 deaths in 2015.[1,2]
- Understanding the drivers of mortality in the past two decades will be useful in achieving 2030 Sustainable Global Development goal of reducing childhood diarrhea associated deaths to less that 1 per 1,000 live births.[3]
- Mathematical modeling suggests drivers for changes in diarrhea mortality include reduction in unsafe sanitation, childhood wasting and an increase in oral rehydration solution coverage.[4,5]
- Primary collected data on diarrheal mortality and risk factors will complement mathematical models to understand the drivers of the decline in diarrhea mortality.

Objective & Hypotheses

1) Quantify the prevalence of diarrhea risk factors and interventions.

2) Assess the relative contribution of these factors on diarrhea mortality.

3) Assess the contribution of change in risk factor prevalence on diarrhea mortality over time.

Hypotheses: We expected to see a decline in risk factors for diarrhea mortality such as unsafe water and sanitation and malnutrition and an increase in interventions to prevent diarrhea mortality such as rotavirus vaccine and oral rehydration solution (ORS) coverage.

We expect changes in rotavirus and oral rehydration solution coverage as well as a reduction in malnutrition to be the biggest drivers in the decline of diarrhea mortality between GEMS and VIDA.

Methods

Participants/study sites:

- GEMS (2008-2011)[6] and VIDA (2015-2018)[7] enrolled children under 5 years old from three study sites: The Gambia, Kenya, and Mali.

Figure 1: VIDA Sites: The Gambia, Kenya, Mali

Study Design:

- Each country site provided a censused population per study through a demographic surveillance system (DSS) updated two to four times per year.
- **CASES**: Children aged 0-59 months with moderate-to-severe diarrhea were enrolled from sentinel health centers.
- **CONTROLS**: Up to 3 controls per case, matched by age, sex, and neighborhood, were randomly selected from the DSS and enrolled within 14 days of the case enrollment. Controls were excluded if they had diarrhea in the previous 7 days.
- Cases and controls were followed up ~60 days for health status.
- The proportion of children with moderate-to-severe diarrhea who sought care at a sentinel health centers (*r*-value; derived from DSS interviews) was used to derive prevalence estimates for the population.

Methods

Statistical Analysis:

- **Prevalence of risks and interventions:** Coverage of ORS for treatment of enrollment diarrhea only taken from cases, all other risks and interventions were taken only from the controls at enrollment. Proportions of cases or controls exposed to each factor, the estimated DSS population, and the *r*-value were used to calculate the population-level prevalence for each factor by age group, site and study. Risks and interventions were established through literature review and data available from GEMS and VIDA.
- **Mortality:** Average annual deaths among cases, the DSS population, and *r*-value for each age group, site, and study.
- **Population attributable fraction (PAF):** We used the causal risk ratio (RR) and theoretical minimal risk exposure level (TMREL) from literature as well as the above calculated prevalence of risk to calculate PAF per factor, age group, site, and study.
- **Drivers of change in diarrhea mortality:** We used a decomposition of the effects of change in risk exposure on the diarrhea mortality rate between GEMS and VIDA while accounting for independent effects of population growth, population ageing, and the underlying mortality rate.

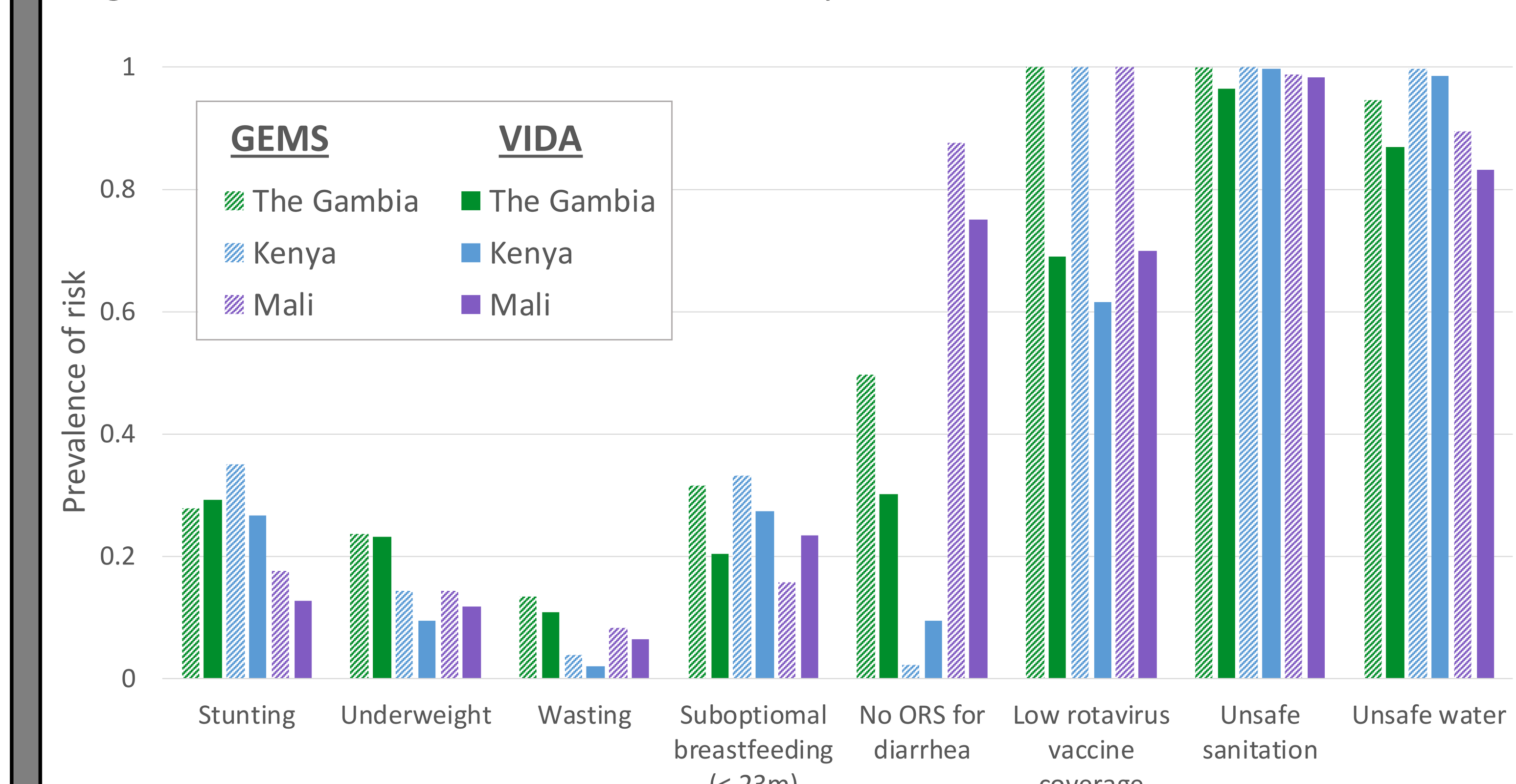
Results

Table 1: Enrollment of cases and controls in GEMS and VIDA across three country sites.

Site	GEMS Cases	GEMS Controls	VIDA Cases	VIDA Controls
Basse & Bansang*, The Gambia	1,029	1,569	1,678	2,138
Nyanza Province, Kenya	1,476	1,883	1,554	2,095
Bamako, Mali	2,033	2,064	1,608	1,980
Total	**4,538**	**5,526**	**4,840**	**6,213**

*GEMS site only included Basse

Figure 2. Prevalence of diarrhea mortality associated risks in GEMS and VIDA



Acknowledgments

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Results

Figure 3. Rate of diarrhea mortality by age, site, and study

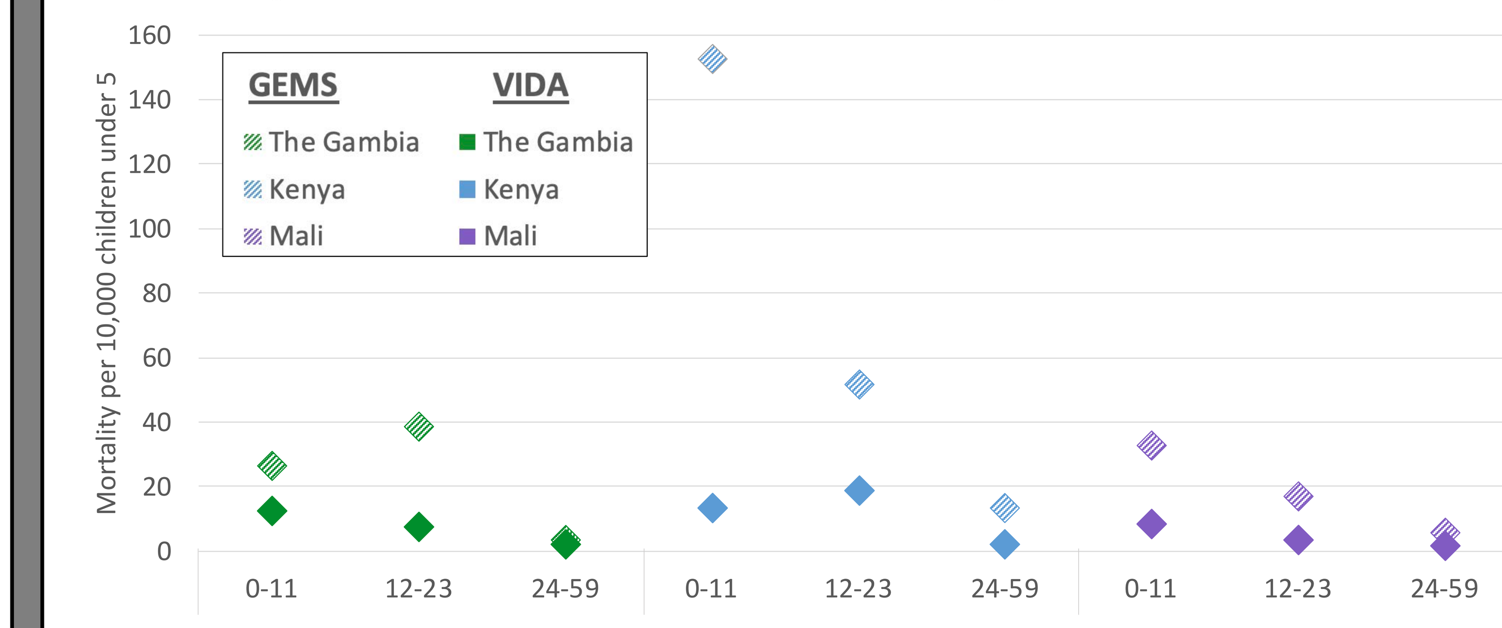

Figure 4. Proportion of VIDA diarrhea mortality attributed to risk factors

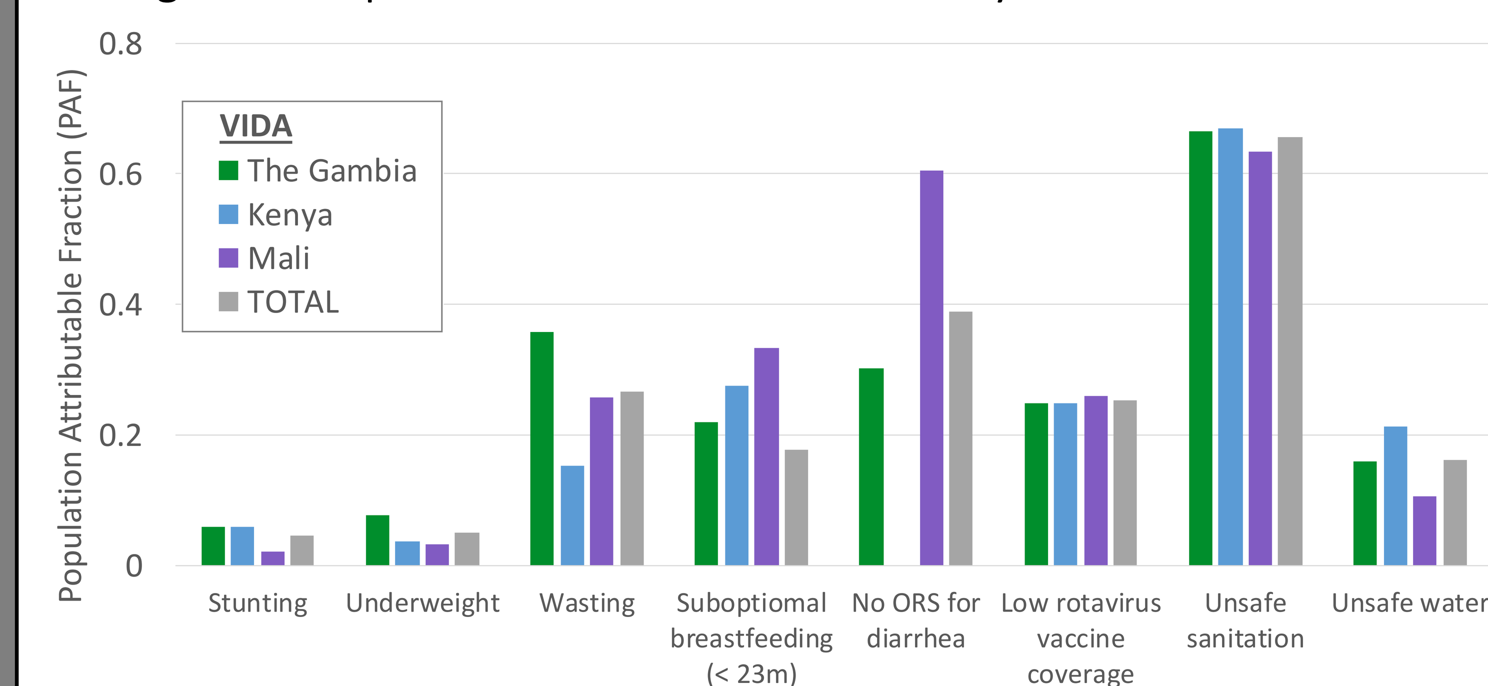

Table 2. Percent change in diarrhea mortality between GEMS and VIDA attributable to change in risk factor exposure by site

	The Gambia	Kenya	Mali	TOTAL
Stunting	-0.59	-1.31	-1.04	-1.06
Underweight	-1.14	-1.41	-1.41	-1.34
Wasting	-17.30	-5.45	-13.00	-10.27
No ORS for diarrhea	-19.40	6.74	-7.86	-3.39
Low Rotavirus Vaccine coverage	-5.68	-4.44	-4.02	-4.65
Suboptimal breastfeeding	-40.12	-36.64	-24.01	-34.25
Unsafe sanitation	-6.07	-4.09	-9.48	-5.90
Unsafe water	-0.31	-2.56	-0.88	-1.58

Quintile: 5th, 4th, 3rd, 2nd, 1st

Summary & Conclusions

- Population prevalence of **wasting** and **unsafe water** decreased and rotavirus vaccine coverage increased.
- The largest decrease of diarrhea related mortality between GEMS and VIDA occurred in the youngest age groups.
- **Unsafe sanitation** appears responsible for ~65% and lack of ORS to treat diarrhea appears responsible for ~38% of all diarrhea deaths during VIDA.
- Decreasing prevalence of **wasting** and **suboptimal breastfeeding** appears to be the greatest contributors to the decrease in diarrhea mortality between GEMS. and VIDA in the three sites.

References

1. GBD Diarrhoeal Diseases Collaborators. 2017 2. Liu *et al.*, 2015 . 3. UN Department of Economic and Social Affairs. 2015. 4. GBD Diarrhoeal Diseases Collaborators. 2019. 5. Black *et al.* 2019. 6. Kotloff *et al* 2012. 7. Kotloff *et al.* Unpublished.