

# Identifying and addressing the excess burden of neural tube defects from CHAMPS Ethiopia: Transforming data to action

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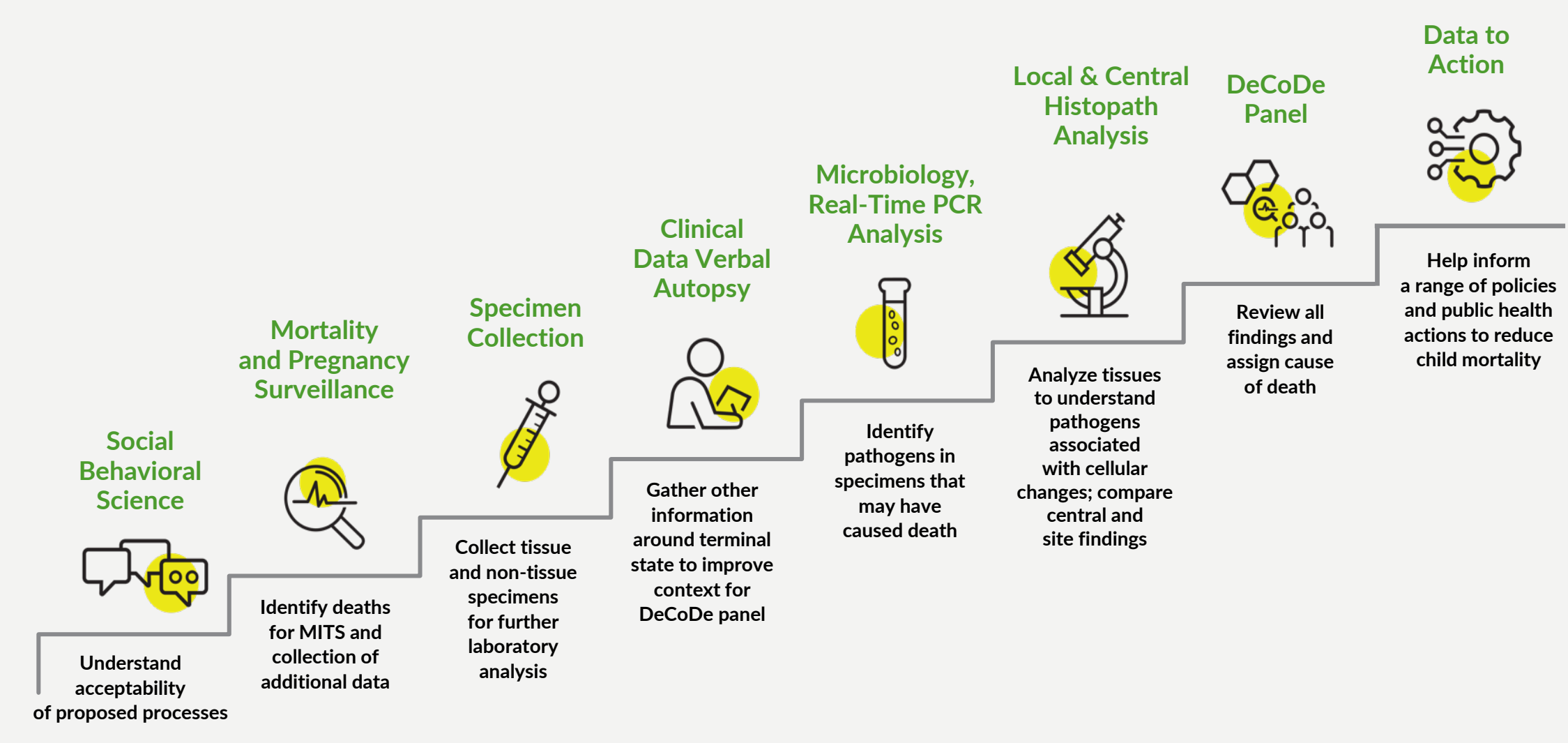
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## Background

- Neural tube defects (NTDs) are common birth defects resulting in severe morbidity and mortality
- NTDs can be largely prevented with periconceptional maternal intake of folic acid.
- Estimates lack precision since comprehensive, population-based data on the mortality attributed to NTDs and associated factors are lacking in low- and lower-middle-income countries due to the lack of robust birth defects surveillance systems, death registration, and linkages between them.
- Understanding the occurrence of NTDs and their contribution to mortality in settings where their burden is highest could inform prevention and healthcare policy.

## Methods

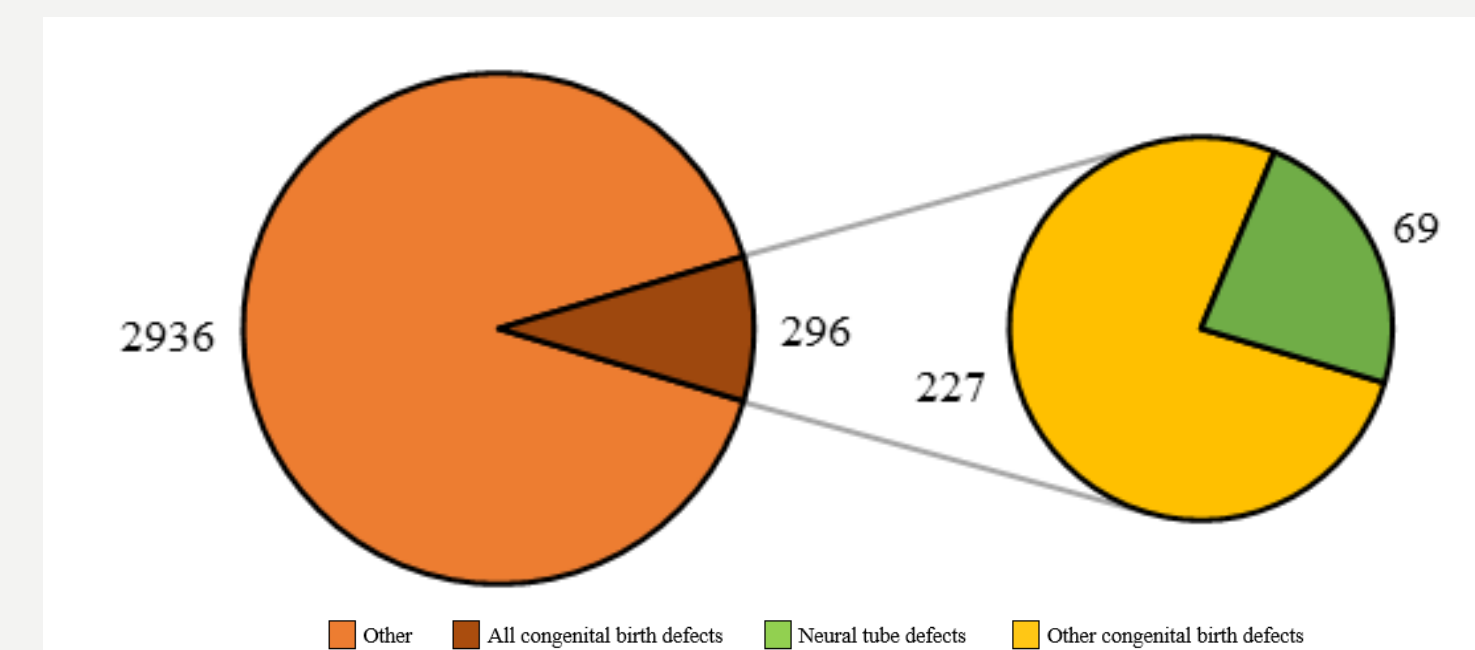
- Child Health and Mortality Prevention Surveillance (CHAMPS) aimed to determine causes of death among stillbirths and deaths children aged under 5 years using Minimally Invasive Tissue Sampling and advanced diagnostic methods.
- CHAMPS and Health Demographic Surveillance System data from South Africa, Mozambique, Bangladesh, Kenya, Mali, Ethiopia, and Sierra Leone were used to describe the frequency and characteristics of NTDs among eligible deaths, identify risk factors, and estimate the mortality fraction and mortality rate (per 10,000 births) by CHAMPS site.



## Results

Causes of death were determined for 3232 deaths occurring from January 2017 through December 2021. Of these, 296 had a congenital birth defect and 69 (2%) died with a NTD (Figure 1), and most of them, 46 (67%) were NTDs cases incompatible with life (Table 1). NTDs deaths were more common in Ethiopia (aOR=8.1, females (aOR=4.4), and among those with no antenatal care (aOR=2.5, (p<0.05) (Table 2). Ethiopia had the highest adjusted mortality fraction of deaths with NTDs (7.5%) and the highest adjusted mortality rate attributed to NTDs (104.0 per 10,000 births), 4-23 times greater than in any other site (Figure 2).

**Figure 1: Frequency of fatal congenital birth defects and NTDs anywhere in the causal chain among all CHAMPS cases consented for MITS**



**Table 1: Frequency of NTD sub-type diagnoses among CHAMPS cases consented for MITS and with NTDs anywhere in the mortality causal chain (2017-2021).**

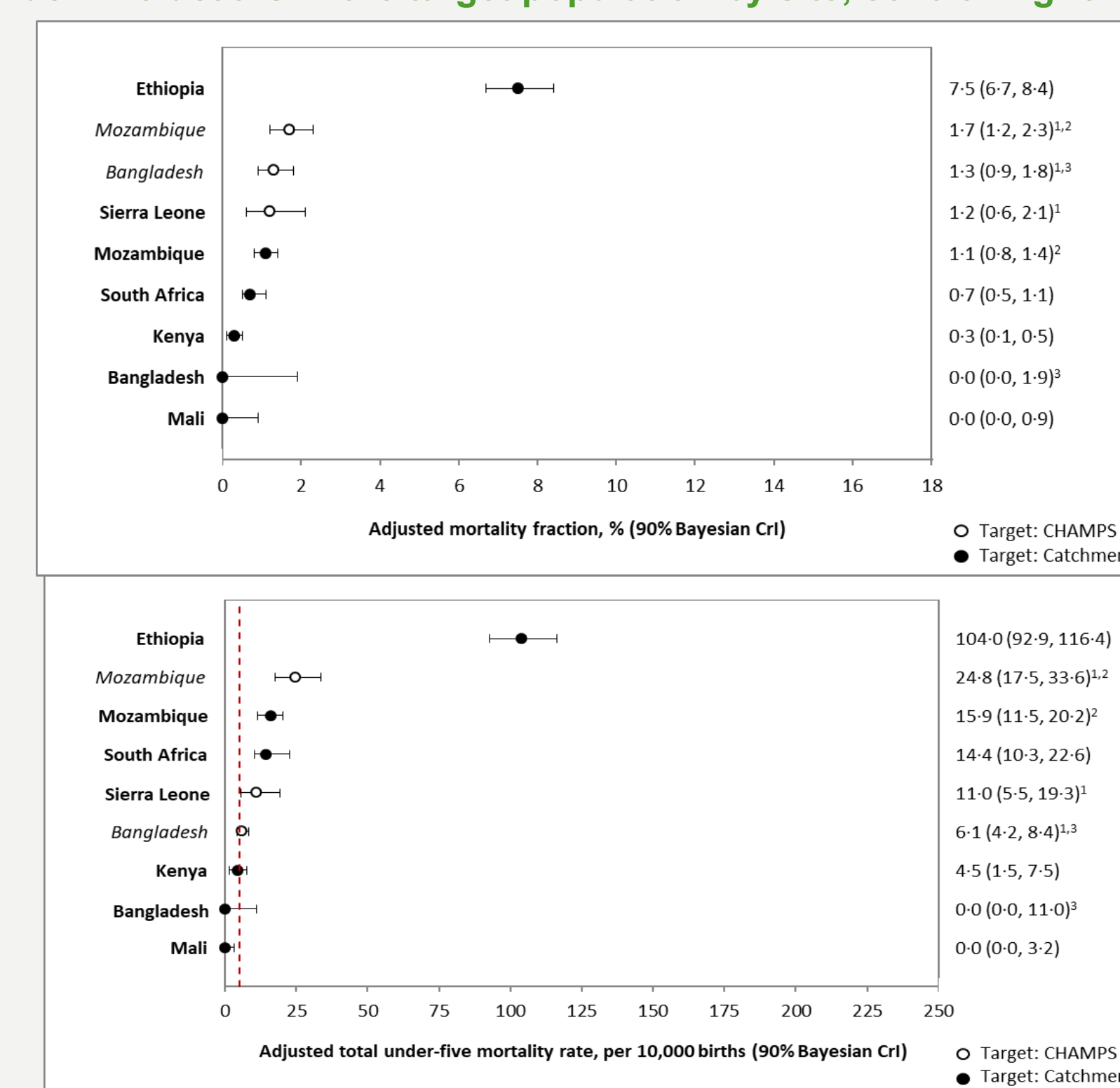
NTD diagnosis	Bangladesh	Ethiopia	Kenya	Mali	Mozambique	Sierra Leone	South Africa	Total
Anencephaly <sup>2-3</sup>	3	6	1	0	7	2	4	23
Craniorachischisis <sup>2-3</sup>	0	19	0	0	0	0	0	19
Iniencephaly <sup>2-3</sup>	0	4	0	0	0	0	0	4
Encephalocele <sup>2-3</sup>	0	0	0	0	1	0	0	1
Spina bifida <sup>2-3</sup>	1	15	0	0	1	2	3	22
Total	4	44	1	0	9	4	7	69

**Table 2: Multivariate logistic regression analysis to identify risk factors for death with a NTD in the causal chain among stillbirths and under-five children in the CHAMPS Network, 2017-2021**

Case Characteristics	aOR <sup>2</sup>	(95% CI)	P-value
<b>Site<sup>1</sup></b>			
Bangladesh	0.32	(0.06, 1.80)	0.194
Ethiopia	8.09	(2.84, 23.0)	<0.001
Kenya	0.17	(0.02, 1.50)	0.110
Mali <sup>3</sup>	0.10	(0.00, 0.50)	0.006
Mozambique	0.78	(0.27, 2.23)	0.645
Sierra Leone	0.61	(0.14, 2.58)	0.501
South Africa	Ref		
<b>Sex<sup>4</sup></b>			
Male	Ref		
Female	4.40	(2.44, 7.93)	<0.001
<b>Maternal Characteristics<sup>5</sup></b>			
<b>Age group<sup>6</sup></b>			
<20 years	2.10	(0.80, 5.54)	0.132
20-24 years	1.99	(0.96, 4.09)	0.063
25-29 years	1.80	(0.89, 3.64)	0.100
≥30 years	Ref		
<b>Religion<sup>7</sup></b>			
Christian	Ref		
Hindu	1.85	(0.17, 20.02)	0.614
Muslim	0.62	(0.29, 1.31)	0.209
Other <sup>8</sup>	0.26	(0.00, 1.19)	0.079
<b>Education<sup>9</sup></b>			
None	0.83	(0.19, 3.67)	0.803
Primary	0.38	(0.04, 3.44)	0.388
Secondary	0.67	(0.13, 3.44)	0.636
Tertiary	Ref		
<b>Alcohol<sup>1</sup></b>			
Yes	4.50	(0.00, 22.26)	0.853
No	Ref		
<b>Smoking<sup>3</sup></b>			
Yes	5.61	(0.00, 28.20)	0.880
No	Ref		
<b>Number of ANC visits<sup>9</sup></b>			
0	2.48	(1.12, 5.51)	0.026
1-2	1.37	(0.56, 3.31)	0.488
3-4	1.11	(0.50, 2.47)	0.794
5-6	1.41	(0.46, 4.29)	0.544
7-8	2.25	(0.28, 17.98)	0.445
9-10	Ref		

<sup>1</sup>Adjusted for age & sex of the child; age, education, religion of the mother; and ANC visits. <sup>2</sup>Cases that did not die due to an NTD did die due to some cause other than an NTD. <sup>3</sup>Exact logistic regression model performed due to sparse data. <sup>4</sup>Adjusted for site; age of the child; age, education, religion of the mother; and ANC visits. <sup>5</sup>All characteristics pertinent to time of pregnancy. <sup>6</sup>Adjusted for site; age, sex of the child; education, religion of the mother; and ANC visits. <sup>7</sup>Adjusted for site; age, sex of the child; age, education, of the mother; and ANC visits. <sup>8</sup>Adjusted for site; age, sex of the child; age, religion of the mother; and ANC visits. <sup>9</sup>Adjusted for site; age, sex of the child; and age, education, religion of the mother.

**Figure 2: Crude and adjusted cause-specific mortality fractions and total under-five mortality rates due to fatal neural tube defects among all stillbirths and under-five deaths in the target population by site, controlling for age**



CrI, credible interval. <sup>1</sup>Target population consists of all cases enrolled in CHAMPS, regardless of MITS consent. <sup>2</sup>Quelimane was included in the estimate where the target population was all CHAMPS cases but excluded when it was the catchment area because DSS data were not available. <sup>3</sup>Fardipur was included in the estimate where the target population was all CHAMPS cases but excluded when it was the catchment area because DSS data were not available. Red line denotes expected rate of 5-6 cases per 10 000 births when an effective national folic acid fortification program is implemented.

## Conclusions

- Our findings highlight NTDs as a relevant cause of death in stillbirths and children aged under five years
- They emphasize the importance of implementing or improving mandatory national food fortification programs with folic acid to reduce the prevalence of NTDs and its associated mortality.
- The findings from Ethiopia, in particular, are alarming, and urgent implementation of food fortification with folic acid could reduce the prevalence of NTDs.
- In Ethiopia, a Data-to-action program has started to determine the prevalence of NTD at the population level and to assess the feasibility and acceptability of a mandatory food fortification program. The program will generate data before and after a food fortification program is well-established in the country.

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See more data at  
[champshealth.org](https://champshealth.org)



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