Maternal HIV status and child growth outcomes in Zimbabwe over time

Emily Groene (groe0074@umn.edu), Robert Valeris-Chacin (valer080@umn.edu), and Anna Stadelman (stad0110@umn.edu)
University of Minnesota
September 15, 2018

Abstract
Few studies have described the association between maternal HIV status and child malnutrition in Zimbabwe over time [1][2][3]. Using data from the 2005-2006, 2010-2011, and 2015 Demographic and Health Surveys (DHS) in Zimbabwe, we compared child stuntedness, underweight, and wasting status between HIV-positive and negative mothers using survey-weighted logistic regression[4]. The adjusted model found that in 2005-2006, children of mothers who were HIV positive were more likely to be stunted (Prevalence Difference (PD)=0.06; 95%CI=0.02 to 0.10; P=0.005) and underweight (PD=0.06; 95%CI=0.02 to 0.09; P=0.001) than children of mothers who were HIV negative. In 2010-2011, boys of mothers who were HIV positive were more likely to be stunted (PD=0.10; 95%CI=0.02 to 0.18; P=0.005) than boys of mothers who were HIV negative. In 2015, there was no association between child malnourishment and maternal HIV status. Overall, there is a decreasing trend in the impact of maternal HIV status on child malnourishment.

Introduction
There is substantive evidence to support an association between the health of the mother and subsequent child malnourishment [5][6][7][8]. However, few studies have described the change in the association between mother's HIV status and malnutrition over time [9][10][11]. We look at Zimbabwe, where interventions to roll out HIV prevention and treatment have been promoted by public and private sector actors, nongovernmental organizations, formal and informal institutions, and intergovernmental organizations that might impact the effect of HIV on child growth. Therefore, this study addressed the gap in the literature of understanding changes in the effect of maternal HIV status on child growth in Zimbabwe over time.

Methods
We analyzed data from the Demographic & Health Survey (DHS) for Zimbabwe, administered in 2005-2006, 2010-2011, and 2015. These surveys include both the Standard DHS Surveys as well as the HIV/Other Biomarkers Datasets, which were linked by case identifiers to show the relationship between mother's HIV status and child growth.

The datasets were restricted to children whose mothers consented to HIV testing. We ascertained our outcome, prevalence of malnourishment among children, using three different binary metrics: stunting, underweight, and wasted. Stunting is defined as more than two standard deviations below the WHO Child Growth Standards (CGS) median of height for age. Underweight is defined as more than two standard deviations below WHO CGS median of weight for age. Wasting is defined as more than two standard deviations below WHO CGS median of weight for height[12].

Our target exposure was HIV positive status of the mother, from the HIV/Other Biomarkers Dataset. We assessed the following variables for a potential confounding effect: mother's age, household wealth index, mother's anemia level (severe, moderate, mild, or none), mother's height for age, mother's BMI, and any tobacco use of the mother (Figure 1). The following variables were evaluated as potential mediators: child birth weight, any vaccination of the child, feeding nutritious food to the child, number of living children, comorbidities, and currently

breastfeeding (Figure 1). As for effect modifiers, the association between mother's HIV status and child growth was evaluated in the levels of child's sex and age [10].

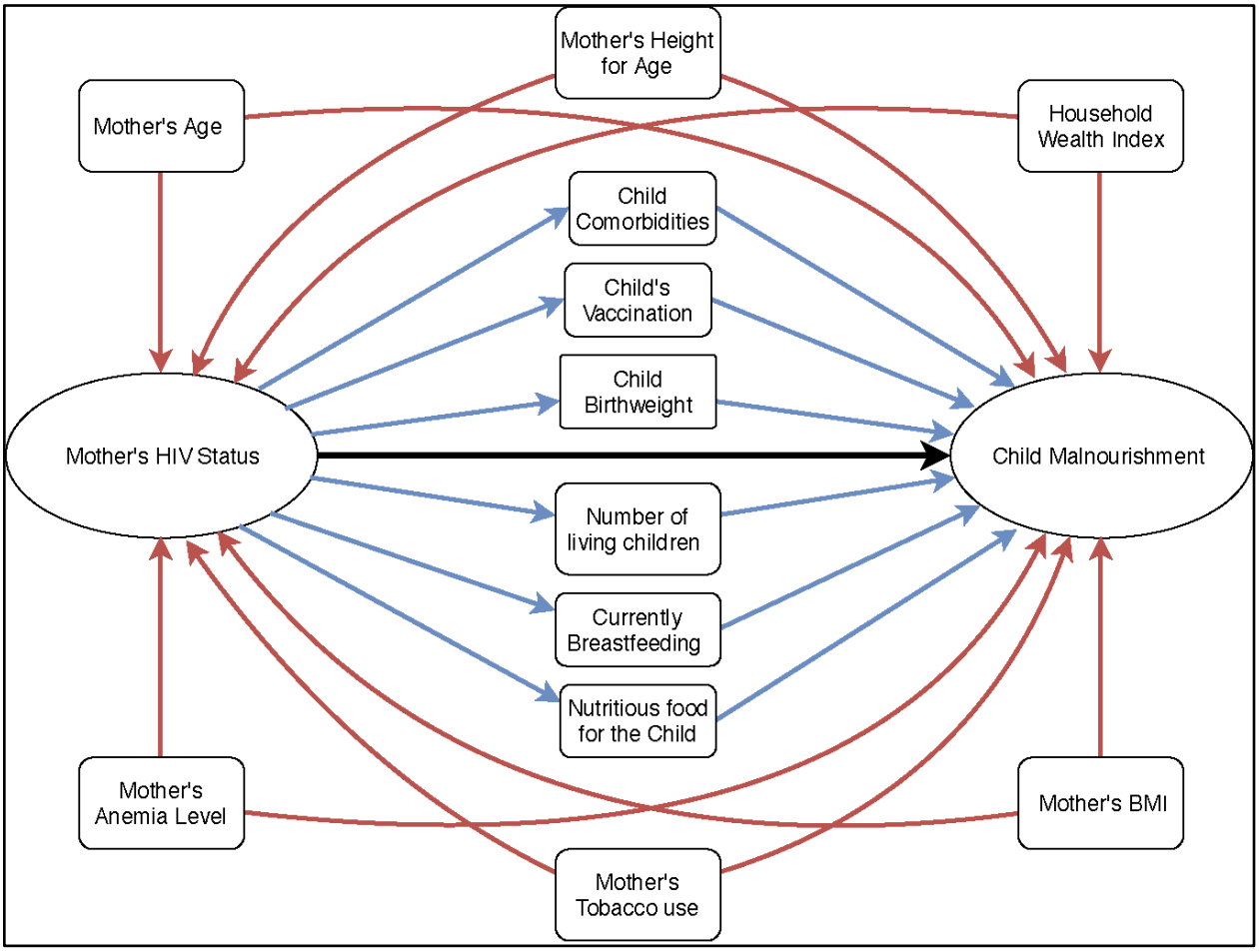

***Figure 1**. Direct Acyclic Graph of the association between Mother's HIV status and Child Malnourishment. Blue arrows indicate mediators and red arrows indicate confounders accounted for in the association between Mother's HIV status and Child Malnourishment*

Findings

In DHS 2005-2006 there were 4,496 children, in DHS 2010-2011 there were 5,563 children, and in DHS 2015 there were 5,577 children (Table 1). Out of those children, there were 2,235 (50%) males in DHS 2005-2006, a total of 2,812 (51%) males in DHS 2010-2011, and 2,755 (49%) males in DHS 2015. There were 3,137 (75%) vaccinated children in DHS 2005-2006, in DHS year 2010 4,528 (87%) children were vaccinated, and 2,980 (94%) vaccinated children in DHS 2015. The proportion of children whose mothers were HIV positive was 22% (n=969) in DHS 2005-2006, 17% (n=840) in DHS 2010-2011, and 16% (n=899) in DHS 2015.

Table 1. Baseline characteristics of the samples by DHS survey

DHS Year	2005-06	2010-11	2015-16

	Mean (SD) or N (%)	Mean (SD) or N (%)	Mean (SD) or N (%)
Child-related Characteristics			
Number of children	4,496	5,563	5,577
Male	2,235 (50%)	2,812 (51%)	2,755 (49%)
Age	1.95 (1.44)	1.80 (1.43)	1.99 (1.42)
Recent illness	1,334 (33%)	1,708 (34%)	2,528 (48%)
Any vaccinations	3,137 (75%)	4,528 (87%)	2,980 (94%)
Mother-related Characteristics			
Age	27.6 (6.58)	27.5 (6.32)	28.5 (6.61)
BMI	22.7 (3.66)	23.5 (4.22)	24.5 (4.64)
HIV-positive	969 (22%)	840 (17%)	899 (16%)
Number of living children	2.79 (1.83)	2.58 (1.60)	2.68 (1.52)
Any tobacco use	22 (0.49%)	27 (0.49%)	14 (0.25%)
Stunted	406 (9.1%)	466 (8.7%)	460 (8.3%)
Currently Breastfeeding	2,162 (48%)	2,694 (48%)	2,257 (40%)
Wealth Index			
Quintile 1 - Poorest	1,191 (26%)	1,366 (25%)	1,149 (21%)
Quintile 2	1,043 (23%)	1,145 (21%)	982 (18%)
Quintile 3	832 (19%)	1,001 (18%)	889 (16%)
Quintile 4	843 (19%)	1,178 (21%)	1,460 (26%)
Quintile 5 - Wealthiest	587 (13%)	873 (16%)	1,097 (20%)

In 2005-2006, the prevalence of stunting was 0.34 (95% CI: 0.31-0.38) among children whose mothers were HIV positive, and 0.28 (95% CI 0.26-0.31) among those whose mothers were HIV negative. In 2010-2011, the prevalence of stunting was 0.31 (95% CI: 0.28-0.36) among children whose mothers were HIV positive, and 0.25 (95% CI: 0.23-0.27) among those whose mothers were HIV negative. In 2015, the prevalence of stunting further decreased to 0.25 (95% CI: 0.21-0.30) among children whose mothers were HIV positive, and 0.2 (95% CI: 0.19-0.22) among those whose mothers were HIV negative. The prevalence of underweight and wasting are shown in table 2.

Table 2. Prevalence and 95% CI of Children Stunted, Underweight, and Wasted by Mother's HIV Status and Child's Gender from 2005-2015

DHS Year	**2005-06**	**2010-11**	**2015-16**

Number of Children	4,569	5,563	5,577
Stunted*			
HIV-positive	0.34 (0.31-0.38)	0.31 (0.28-0.36)	0.25 (0.21-0.30)
Male	0.38 (0.32-0.43)	0.37 (0.32-0.43)	0.27 (0.21-0.33)
Female	0.31 (0.27-0.36)	0.25 (0.21-0.31)	0.23 (0.18-0.30)
HIV-negative	0.28 (0.26-0.31)	0.25 (0.23-0.27)	0.20 (0.19-0.22)
Male	0.29 (0.26-0.32)	0.26 (0.24-0.29)	0.21 (0.19-0.24)
Female	0.27 (0.24-0.30)	0.24 (0.22-0.26)	0.19 (0.17-0.22)
Underweight*			
HIV-positive	0.21 (0.18-0.25)	0.15 (0.13-0.19)	0.15 (0.12-0.18)
Male	0.22 (0.18-0.27)	0.18 (0.14-0.23)	0.12 (0.09-0.17)
Female	0.21 (0.16-0.26)	0.13 (0.10-0.17)	0.17 (0.13-0.22)
HIV-negative	0.16 (0.14-0.18)	0.14 (0.12-0.15)	0.11 (0.10-0.12)
Male	0.15 (0.14-0.17)	0.14 (0.12-0.16)	0.11 (0.10-0.13)
Female	0.16 (0.13-0.19)	0.13 (0.11-0.15)	0.11 (0.09-0.13)
Wasted*			
HIV-positive	0.06 (0.05-0.09)	0.03 (0.02-0.05)	0.04 (0.03-0.06)
Male	0.07 (0.05-0.11)	0.04 (0.02-0.07)	0.04 (0.02-0.08)
Female	0.06 (0.02-0.12)	0.02 (0.01-0.05)	0.05 (0.03-0.07)
HIV-negative	0.06 (0.05-0.07)	0.03 (0.03-0.04)	0.04 (0.03-0.04)
Male	0.06 (0.04-0.07)	0.03 (0.02-0.04)	0.04 (0.03-0.05)
Female	0.06 (0.05-0.07)	0.03 (0.02-0.04)	0.03 (0.03-0.04)

**Prevalences are survey-weighted proportions.*

In DHS 2005-2006, children of mothers who were HIV positive were more likely to be stunted than children of mothers who were HIV negative (PD=0.06; 95%CI=0.02 to 0.10; P=0.005) (Figure 2). In this same year, children of mothers who were HIV positive were more likely to be underweight than children of mothers who were HIV negative (PD=0.06; 95%CI=0.02 to 0.09; P=0.001). In DHS 2010-2011, boys of mothers who were HIV positive were more likely to be stunted (PD=0.10; 95%CI=0.02 to 0.18; P=0.005) than boys of mothers who were HIV negative (Figure 2). There was no evidence of significant differences in the prevalence of stunting (DHS 2015), underweight (DHS 2010-2011, and DHS 2015), and wasting (DHS 2005-2006, DHS 2010-2011, and DHS 2015) between children whose mothers were either HIV positive or HIV negative.

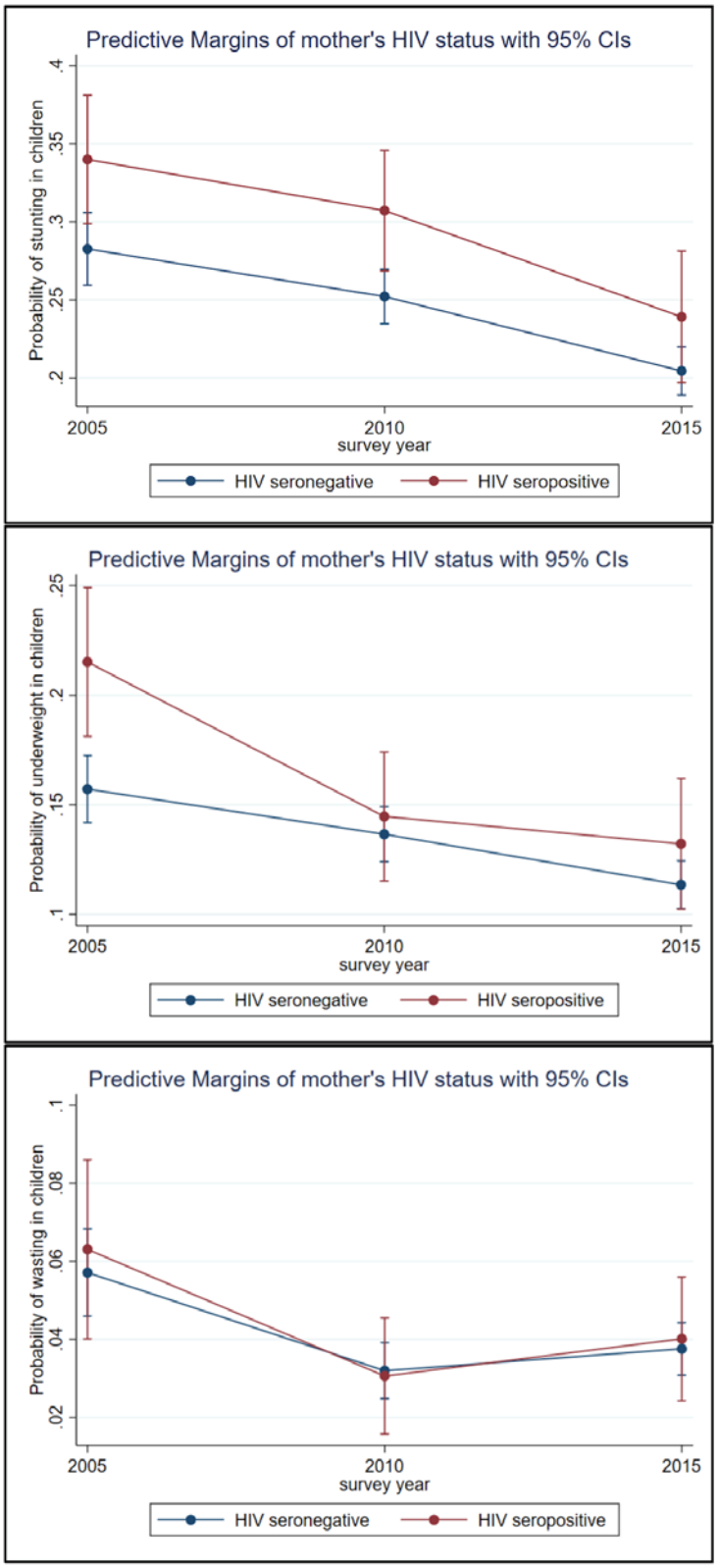

Figure 2. *Prevalence trends of stuntedness (upper graph), underweight (middle graph), and wasting (bottom graph) in children born to HIV positive and negative mothers in Zimbabwe from 2005-2015.*

Conclusion

While severe malnutrition has increased over the last decade, deaths from HIV continue to fall – from 61,000 in 2013 to 30,000 in 2016.[1] The long-term effects of the disease should be considered, particularly for children of HIV positive parents. This research could inform targeting of nutrition programs toward families impacted by HIV/AIDS, and could be a metric of impact for current HIV programming.

Our preliminary results provide evidence that the relationship between HIV positive status and child malnutrition has been decreasing over time. Next steps in the analysis will include a mediation analysis to ascertain the role of child birth weight, vaccination of the child, feeding nutritious food to the child, number of living children, comorbidities, and currently breastfeeding, as indirect pathways of the association between mother's HIV status and child malnutrition. Future research using prospective cohort designs could further substantiate the relationships we observed by following the same individuals over time.

References

1. Center for Public Impact.

"Tackling Malnutrition in Zimbabwe." (2017). https://www.centreforpublicimpact.org/case-study/tackling-malnutrition-zimbabwe/

2. Dinh, T.-H., Mushavi, A., Shiraishi, R. W., Tippett Barr, B., Balachandra, S., Shambira, G., … Kilmarx, P. H. (2018). Impact of Timing of Antiretroviral Treatment and Birth Weight on Mother-to-Child Human Immunodeficiency Virus Transmission: Findings From an 18-Month Prospective Cohort of a Nationally Representative Sample of Mother–Infant Pairs During the Transition From Option A to Option B+ in Zimbabwe. Clinical Infectious Diseases, 66(4), 576–585. https://doi.org/10.1093/cid/cix820
3. Demographic and Health Surveys (DHS) - Zimbabwe 2005-2006, 2010, and 2015 Malnutrition on the rise in Zimbabwe as El Nino takes its toll, 15 March 2016, UNICEF Zimbabwe. https://www.unicef.org/zimbabwe/media_18004.html
4. Mason, J. B., Bailes, A., Mason, K. E., Yambi, O., Jonsson, U., Hudspeth, C., … Martel, P. (2005). AIDS, drought, and child malnutrition in southern Africa. Public Health Nutrition, 8(06). https://doi.org/10.1079/PHN2005726
5. Piwoz, E. G., & Bentley, M. E. (2005). Women's Voices, Women's Choices: The Challenge of Nutrition and HIV/AIDS. The Journal of Nutrition, 135(4), 933–937. https://doi.org/135/4/933 [pii]
6. UNAIDS (2017) 'Data Book'. http://www.unaids.org/sites/default/files/media_asset/20170720_Data_book_2017_en.pdf
7. Zimbabwe National Statistics Agency - ZIMSTAT - and ICF International. 2012. Zimbabwe Demographic and Health Survey 2010-11. Calverton, Maryland, USA: ZIMSTAT and ICF International.
8. Zimbabwe's National HIV and AIDS Strategic Plan 2011-2015 http://www.unaids.org/sites/default/files/country/documents/ZWE_narrative_report_2016.pdf
9. Thistle, P., Bolotin, S., Lam, E., Schwarz, D., Pilon, R., Ndawana, B., … Silverman, M. (2011). Highly active anti-retroviral therapy in the prevention of mother-to-child transmission of HIV in rural Zimbabwe during the socio-economic crisis. Medicine, Conflict and Survival, 27(3), 165–176. https://doi.org/10.1080/13623699.2011.631752Mason, J. B., Chotard, S., Bailes, A., Mebrahtu, S., & Hailey, P. (2010). Impact of drought and HIV on child nutrition in Eastern and Southern Africa. Food and Nutrition Bulletin, 31(3 Suppl). https://doi.org/10.1177/15648265100313S301
10. Gibb, D. M., Kizito, H., Russell, E. C., Chidziva, E., Zalwango, E., Nalumenya, R., … Musoke, P. (2012). Pregnancy and infant outcomes among HIV-infected women taking long-term art with and without tenofovir in the DART trial. PLoS Medicine, 9(5). https://doi.org/10.1371/journal.pmed.1001217
11. UNICEF. (n.d.). UNICEF - Definitions. Retrieved September 14, 2018, from

https://www.unicef.org/infobycountry/stats_popup2.html