The Crucial Role of Siblings on Child Survival: Evidence from 29 Health and Demographic Surveillance Systems in sub-Saharan Africa

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Introduction

Although under-five mortality has declined significantly worldwide, it remains highest in sub-Saharan Africa (SSA). Thus, understanding the mechanisms, in particular the proximate determinants, that drive child mortality is an important step, underpinning healthcare policies. Maternal factors including birth intervals have long been identified as key proximate determinants of child mortality (Boerma and Bicego 1992; Da Vanzo et al. 2008; Mosley and Chen 1984; Rutstein 2005). Adequate spacing avoids competition for care between children, lowers disease transmission between siblings and allows for mothers to recover from the physiological demands of pregnancy and breastfeeding. Despite this, because most research looks at older siblings, a pre-birth interval has been neglected. That is, during pregnancy with a younger sibling, there may already be an effect on child mortality.

In addition to the presence of a sibling close in age increasing a child's risk of death, the absence of a sibling, due to migration or death, can also be detrimental. Death often clusters within families since children share similar genetics and environments including maternal care and disease transmission (Das Gupta 1990; van Dijk 2018). When a sibling migrates it may on the one hand reduce competition and spread of diseases, but on the other hand sibling migration may indicate family breakup or the lack of stability in the household, and be associated with maternal migration too.

We is longitudinal data to disentangle the effects of siblings – their absence by migration or death, and when they are present, how close the birth intervals are – on child mortality. Health and Demographic Surveillance Systems (HDSS) provide valuable temporally accurate data for low and middle-income countries, capturing all births, deaths, in- and out-migrations within a geographically defined population. Considering the paucity of dated longitudinal data in SSA, they provide a unique opportunity to address sibling-related determinants of child mortality, as well as demonstrate how complex effects on under-five mortality can be derived from readily available data.

We hypothesis that the effect of having a co-resident older sibling is lower than having a younger co-resident sibling. In addition, the effect of having a younger sibling may even begin before birth, that is, while the mother is pregnant, since breastfeeding patterns may change. We also hypothesis that the death

of an older sibling has a similar effect on child mortality as that of a death of a younger sibling. Finally, we expect that the migration of a sibling (whether older or younger) may increase chid mortality if it is an indicator of family disruption, but may lower child mortality since infectious disease transmission between them is bypassed.

Methodology

Data from 29 HDSS sites in 12 SSA countries, readily available from the International Network for the Demographic Evaluation of Populations and Their Health (Sankoh and Byass 2012), are pooled together to provide data on over 560,000 children born on sites, and 40,650 deaths of under-five year olds. The sites range in years covered, and pooled together ranges from 1990 to 2016. Although the HDSSs do not cover the whole of SSA and are not nationally representative, they are sufficiently diverse to illustrate heterogeneous contexts across SSA, and convergence at the continental level (Byass 2016; Utazi et al. 2016, 2018). What we lose with using the HDSS data in terms of representativeness we gain in terms of statistical power and understanding of complex mechanisms leading to child death (Bocquier et al. 2017). Our analysis uses a proportional hazard semi-parametric model with site-time period fixed effects, the role of younger and older siblings on child mortality while also controlling for sex, twin status, maternal age at birth, maternal death and migration.

Results

Our results indicate that younger sibling effects are more pronounced than older sibling effects. When a younger sibling migrates the risk of child death is 70% higher, while when an older sibling migrates, the risk of death is 26% higher. Both older and younger sibling's death is bell-shaped (Figure 1), that is, risk is highest for index child to die around 15 days before and 15 days after a sibling's death- but this peak is only significant with younger siblings (hazard ratio of 5.5 with confidence interval between 4.1- 7.2). The effect of maternal death on child mortality is high before her death, likely suffering drawn-out illness and unable to care for children. This effect is highest 15 days to 3 months after her death, and remains relatively high 3 to 6 months after her death.

Additionally, the period before pregnancy with the younger sibling is most favourable for child survival. The pregnancy effect depends on the birth interval with the younger sibling, and the risk of child death increases over the pregnancy period and soon after birth- and this pattern is stronger when the birth interval is shorter (Figure 2). Children with birth intervals of less than 12 months (with both older and younger siblings) have higher risk of mortality.

Figure 1: Effect of mother and sibling death in under-five mortality in SSA

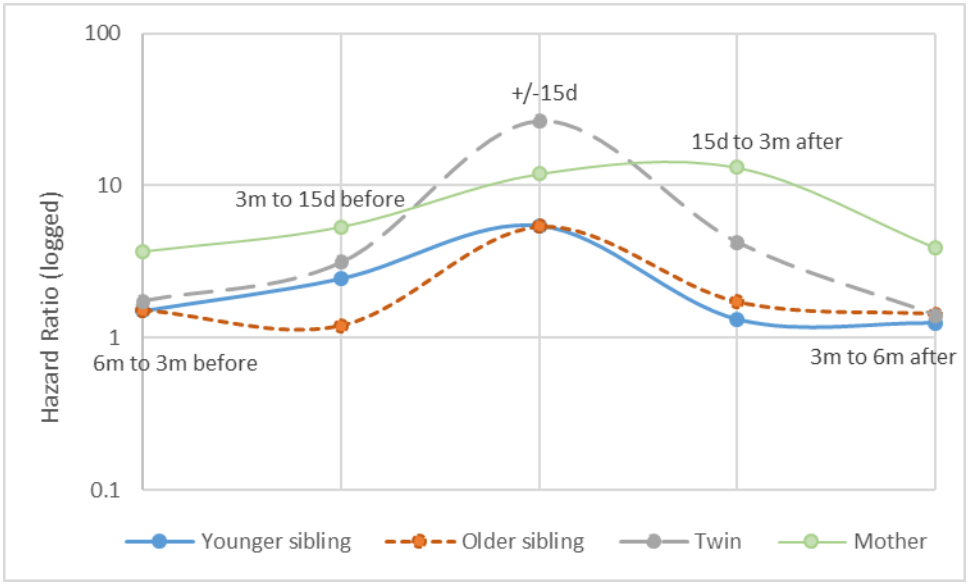
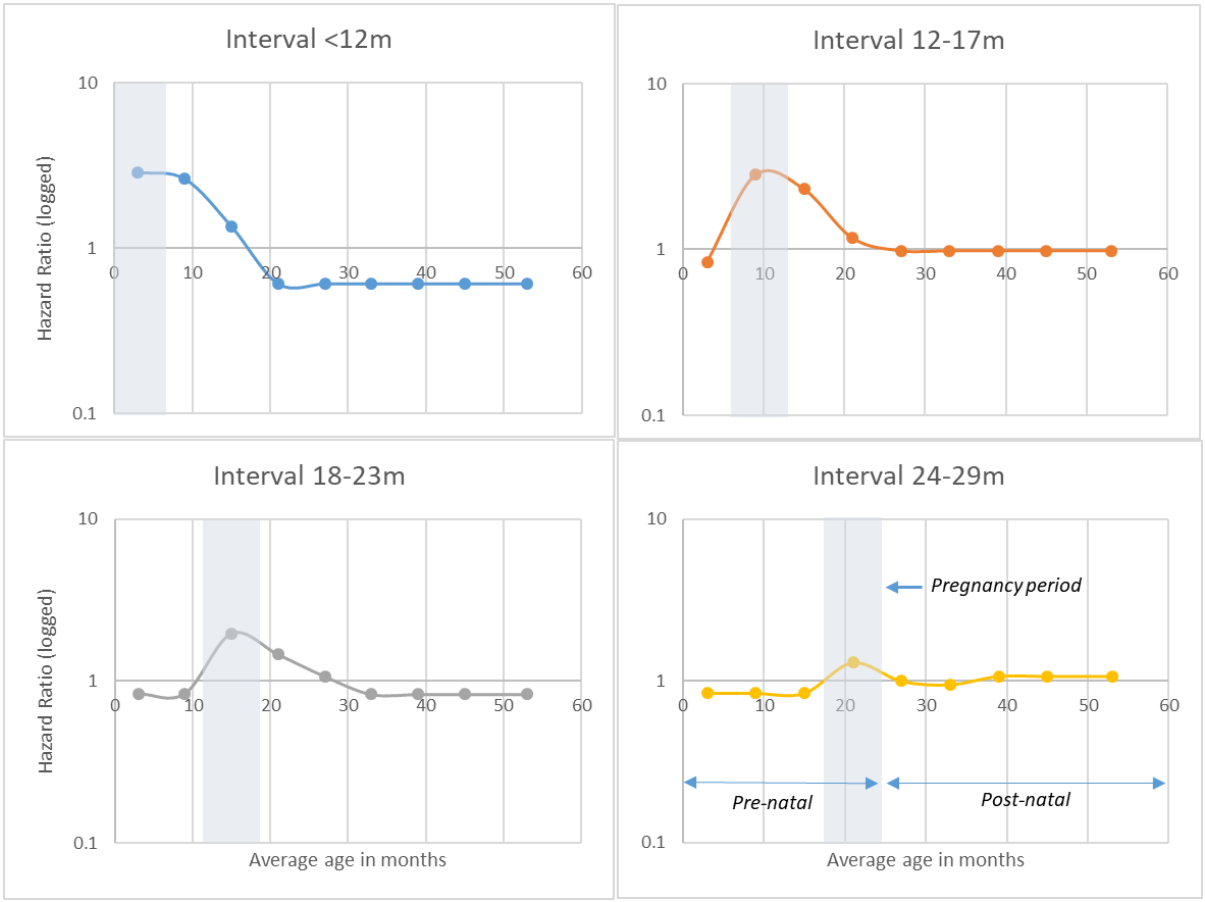


Figure 2: Combined effects of pre- and post-natal and birth interval with younger sibling



References

Bocquier, P., Sankoh, O., & Byass, P. (2017). Are health and demographic surveillance system estimates sufficiently generalisable? *Global Health Action*, *10*(1). doi:10.1080/16549716.2017.1356621

Boerma, J. T., & Bicego, G. T. (1992). Preceding Birth Intervals and Child Survival: Searching for Pathways of Influence. *Studies in Family Planning*, *23*(4), 243. doi:10.2307/1966886

Byass, P. (2016). Cause-specific mortality findings from the Global Burden of Disease project and the INDEPTH Network. *The Lancet Global Health*, *4*(11), e785–e786. doi:10.1016/S2214-109X(16)30203-0

Da Vanzo, J., Hale, L., Razzaque, A., & Rahman, M. (2008). The effects of pregnancy spacing on infant and child mortality in Matlab, Bangladesh: How they vary by the type of pregnancy outcome that began the interval. *Population Studies*, *62*(2), 131–154. doi:10.1080/00324720802022089

Das Gupta, M. (1990). Death clustering, Mothers' education and the determinants of child mortality in rural Punjab, India. *Population Studies*, *44*(3), 489–505. doi:10.1080/0032472031000144866

Mosley, W. H., & Chen, L. C. (1984). An Analytical Framework for the Study of Child Survival in Develoiping Countries. *Population and Development Review*, *10*(Suppl), 25–45.

Rutstein, S. O. (2005). Effects of preceding birth intervals on neonatal, infant and under-five years mortality and nutritional status in developing countries: Evidence from the demographic and health surveys. *International Journal of Gynecology and Obstetrics*, *89*(SUPPL. 1). doi:10.1016/j.ijgo.2004.11.012

Sankoh, O., & Byass, P. (2012). The INDEPTH network: Filling vital gaps in global epidemiology. *International Journal of Epidemiology*, *41*(3), 579–588. doi:10.1093/ije/dys081

Utazi, C. E., Sahu, S. K., Atkinson, P. M., Tejedor, N., & Tatem, A. J. (2016). A probabilistic predictive Bayesian approach for determining the representativeness of health and demographic surveillance networks. *Spatial Statistics*, *17*, 161–178. doi:10.1016/j.spasta.2016.05.006

Utazi, C. E., Sahu, S. K., Atkinson, P. M., Tejedor-Garavito, N., Lloyd, C. T., & Tatem, A. J. (2018). Geographic coverage of demographic surveillance systems for characterising the drivers of childhood mortality in sub-Saharan Africa. *BMJ Global Health*, *3*(2), e000611. doi:10.1136/bmjgh-2017-000611

van Dijk, I. K. (2018). Early-life mortality clustering in families: A literature review. *Population Studies*, *73*(1), 79–99. doi:10.1080/00324728.2018.1448434