Global, regional, and national-level estimates of maternal bereavement due to stillbirths and neonatal death

Abstract

Each year, millions of stillbirths and neonatal deaths leave behind bereaved mothers whose long term physical and mental health may be significantly impacted. Yet, the implications of these profound losses for maternal wellbeing are often overlooked in global health frameworks like the Sustainable Development Goals, which treat maternal outcomes separately from stillbirth and neonatal mortality. We develop new indicators to estimate the risk that a woman will experience stillbirth or neonatal death over her life course. Our preliminary country-level estimates revealed stark inequities, with lifetime risk of either stillbirth or neonatal death as high as 1 in every 2.4 women in Somalia and as low as 1 in 439.8 in the Republic of Korea. The findings enhance our understanding of how rates of fertility, mortality, and pregnancy loss come together to shape an individual's risk of experiencing maternal bereavement, along with its far-reaching consequences for health and livelihoods.

Extended abstract

1. Introduction

Globally, there are around 5 million stillbirths and neonatal deaths every year (1,2), and for each one of these deaths, there is a mother left behind, who suffers the direct and indirect consequences of losing a baby. The event of bereavement due to the loss of a child can increase the risk of severe maternal complications as well as subsequent physical and mental health conditions. Women who experience stillbirth are more likely to experience intrapartum complications in the current pregnancy and future pregnancies (3,4). Stillbirth and neonatal death may also have maternal cardiovascular and metabolic consequences (5) and increase the risk of mental health disorders (6). From an indirect perspective, experiencing a stillbirth or the loss of a child could impact care-seeking behavior and utilization, and lead to increased risk of substance misuse (7,8). Stillbirth and neonatal mortality are, therefore, significant life course events that may fundamentally alter a woman's future health trajectory. Despite this, current global measures of health, and targets for improving health, such as the disability-adjusted life years (DALYs) and the Sustainable Development Goals (SDGs), consider maternal health outcomes in isolation from the experience of stillbirth or neonatal loss. Furthermore, while efforts to improve stillbirth surveillance have been gaining momentum, stillbirths themselves represent a vital though often neglected topic in the maternal health agenda which were excluded from the SDGs.

We develop a set of new indicators to estimate a woman's risk of experiencing maternal bereavement due to stillbirth and neonatal mortality. Our methods adapt and expand upon previous work on lifetime risk of maternal near miss morbidity (9). The proposed indicators provide insight into the burden of stillbirth and neonatal mortality at the woman-level, which is not captured by conventional indicators that express such events per live births or child-level exposure time. They also take into account that women are repeatedly exposed to the risk of experiencing a stillbirth or neonatal death during their reproductive lives, and that such risk accumulates.

We compare maternal bereavement indicators across all countries and with respect to a five-phase maternal mortality, stillbirth, and neonatal mortality transition model. Our findings highlight significant regional inequities in the risk of maternal bereavement and all of its downstream consequences to health and livelihoods. This work demonstrates the intrinsic links between maternal wellbeing and reproductive and child health outcomes, and how this relationship may vary across contexts and stages of the transition.

2. Methods

We use publicly available country-level data on stillbirths and neonatal mortality from UNICEF (2,10) and fertility and adult mortality from the UN *World Population Prospects*, published by the United Nations Population Division (11). We use a synthetic cohort to estimate the lifetime risk (1 in N chance) that a woman aged 15 years will experience stillbirth (i.e. fetal death from 28 weeks gestation; LTR-STB), neonatal death (i.e. child death within the first 28 days of life; LTR-NM), or either stillbirth or neonatal death by age 50 years (LTR-

LOSS). Estimates were generated for 199 countries and territories, SDG regions, and years between 2000 and 2023.

The formula for each proposed LTR indicator is shown in equations 1-3. The first inputs of the LTR-STB and LTR-NM are the stillbirth (SBR) and neonatal mortality rates (NMR), respectively. These are multiplied by the net reproductive rate (NRR; the number of daughters a woman is expected to give birth to if subject to prevailing fertility and mortality rates over her lifetime) and the sex ratio at birth (SRB; the number of male births for every female birth). Taken together, the product of the NRR and SRB proxy a woman's repeated exposure to the risk of pregnancy, accounting for survival during reproductive ages of 15-49 years. The final input uses the life table survival curve to condition the quantity on survival up to age 15 years. LTR-LOSS is calculated as the sum of LTR-STB and LTR-NM.

$$(1)\quad LTR\text{-}STB = SBR * NRR \frac{\left(\frac{SRB}{100}+1\right) * l_0}{l_{15}}$$

$$(2)\quad LTR\text{-}NM = NMR * NRR \frac{\left(\frac{SRB}{100}+1\right) * l_0}{l_{15}}$$

$$(3)\quad LTR\text{-}LOSS = LTR\text{-}STB + LTR\text{-}NM$$

We assess levels and trends in the LTR indicators by country and global region. We also examine how our new indicators relate to conventional measures of fertility, stillbirth, neonatal and maternal mortality, highlighting cases where the LTR indicators produce different country rankings or reveal distinct patterns of risk over time. Finally, we assess LTR-STB, LTR-NM, and LTR-LOSS with respect to each country's stage of the maternal mortality, stillbirth, and neonatal mortality transition. We use these benchmarks to identify typical patterns of LTR indicators with respect to health system transition, and identify countries that are positive-outliers (12), in the sense that they have lower than expected LTR-STB, LTR-NM, and LTR-LOSS given their transition stage.

3. Preliminary Results

We present preliminary results for LTR-LOSS in all countries in 2023 in Figure 1. LTR-LOSS is highest in the sub-Saharan African region where it is estimated that 1 in every 2.4 women will experience a stillbirth or neonatal death in their reproductive lifetime in Somalia, 2.8 in Central African Republic, 3.0 in Chad, 3.1 in Niger, and 3.4 in the Democratic Republic of Congo. Outside of sub-Saharan Africa, the highest risks are found in Afghanistan (3.4) and Pakistan (4.3).

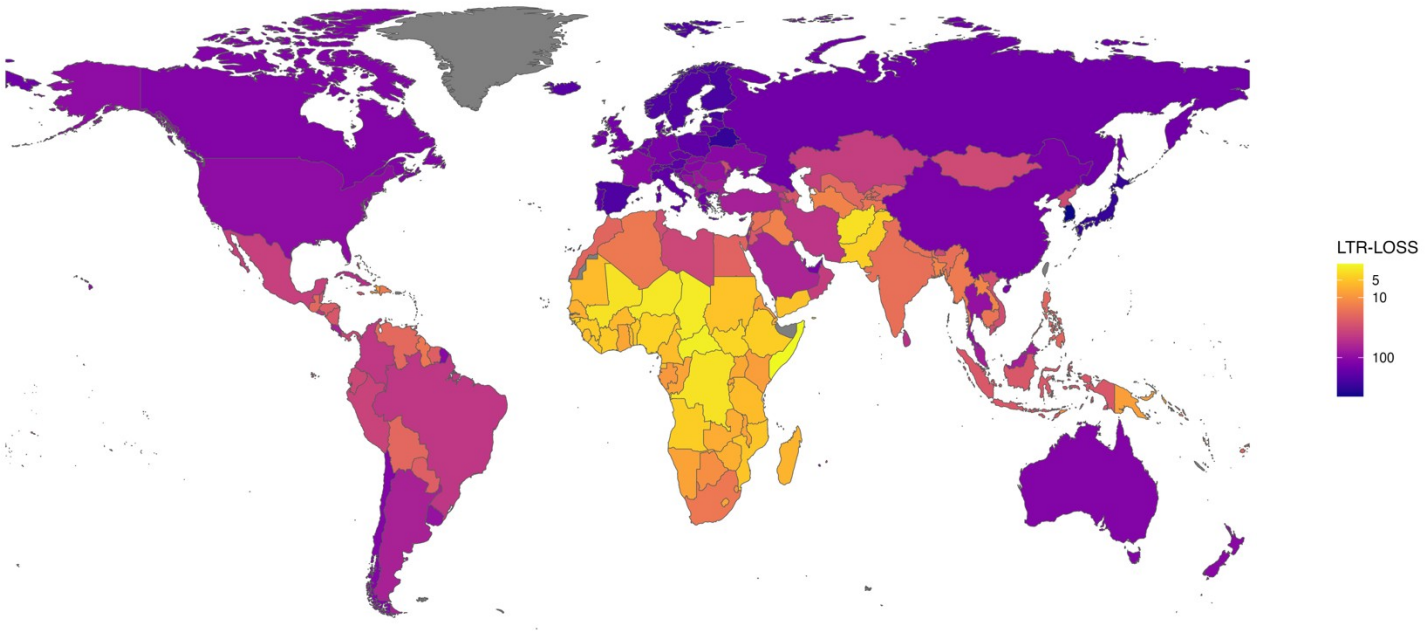

Figure 1: Lifetime risk of stillbirth or neonatal death (LTR-LOSS) in all countries in 2023.

In Figure 2, we display LTR-STB, LTR-NM, and LTR-LOSS in combination with the total fertility rate (TFR) in sub-Saharan Africa. Countries are classified into a 3×3 bivariate grid based on quantiles of the two indicators. In purple-shaded countries, both TFR and LTR fall into the same relative quantile category (e.g., both high, both medium, or both low). Countries shaded in blue have relatively higher TFR and lower LTR values, while those shaded in red have relatively higher LTR values at lower fertility levels.

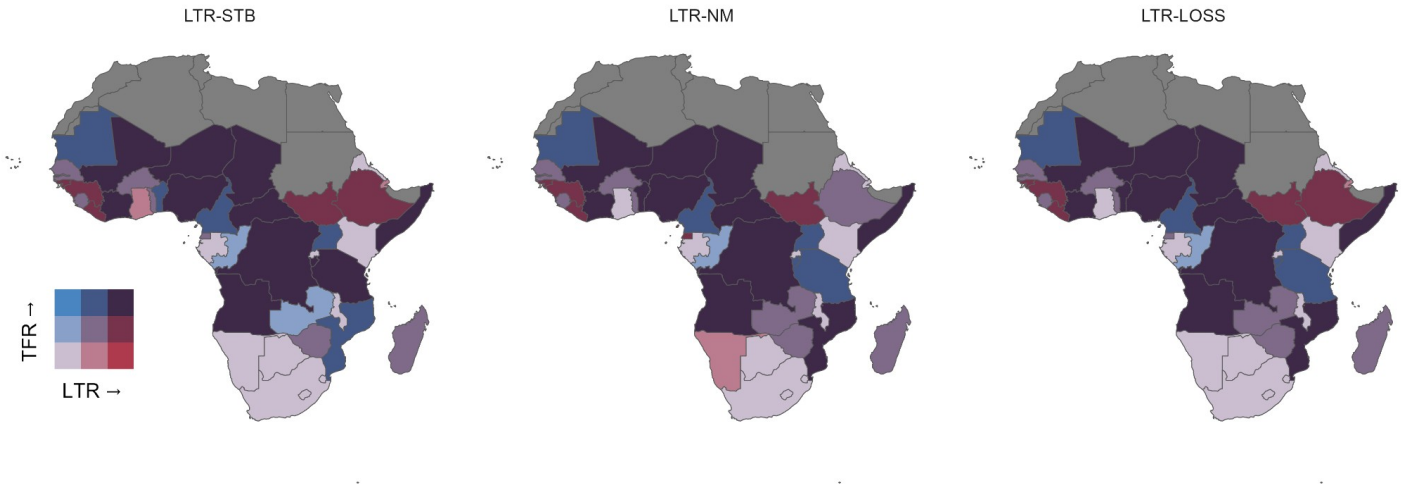

Figure 2: Lifetime risk of stillbirth (LTR-STB), neonatal death (LTR-NM), or both (LTR-LOSS) and total fertility rate in sub-Saharan Africa in 2023.

In approximately 80% of cases, countries that are shaded blue, purple, or red in LTR-STB have the same shade in LTR-NM. In other words, the quantile rankings for LTR-STB and LTR-NM are similar and LTR-LOSS

is an adequate summary measure. However, in certain cases, countries may have relatively high LTR-STB but low LTR-NM for a given level of TFR (e.g. Ghana, Ethiopia) or vice versa (e.g. Benin, Namibia, Mozambique, Zambia).

In Figure 3, we display the contribution of LTR-STB to LTR-LOSS in 2023 for countries with the lowest and highest levels of risk. Countries are color-coded by their stage in the five-phase maternal mortality, stillbirth, and neonatal mortality transition model. All countries with the lowest rates of LTR-LOSS are all classified as having reached stage 5 of the transition model, characterized by the lowest maternal (<20 per 100 000 livebirths) and stillbirth plus neonatal (<15 per 1000 births) mortality (13). In such settings, stillbirths tend to account for a relatively larger share of LTR-LOSS compared to high burden countries.

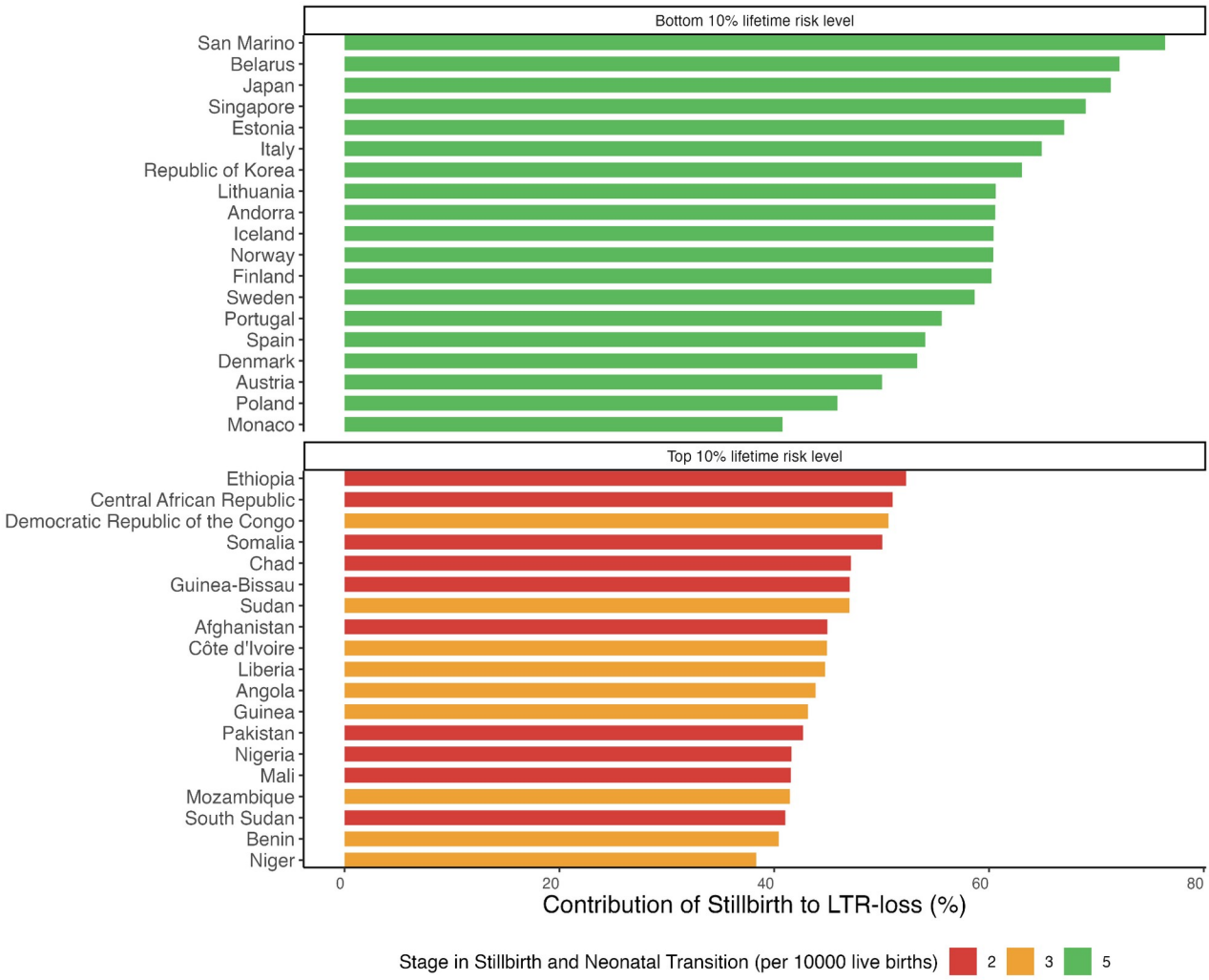

Figure 3: Relative contribution of lifetime risk of stillbirth (LTR-STB) to lifetime risk of stillbirth or neonatal death (LTR-LOSS) in highest and lowest LTR-LOSS countries in 2023. Countries are shared by their stage in the mortality, stillbirths, and neonatal mortality transition model.

In countries with the highest LTR-LOSS in 2023, stillbirths tend to account for <50% of the total risk, with the remaining contribution coming from neonatal deaths. These countries are in stages 2 and 3 of the transition, tending to have higher mortality rates, lower total health expenditure, fewer per capita health workers, and lower rates of institutional deliveries (among other markers). Ethiopia, Central African Republic, and Somalia stand out as countries at early stages of the transition (i.e., higher mortality) with relatively high contributions of stillbirths to LTR-LOSS.

4. Further directions

By the time of the conference, we will have analyzed the relationship between the new LTR indicators and rates of stillbirth, neonatal, and maternal mortality. Characterizing these relationships will permit the identification and further investigation of aberrational cases where maternal bereavement is higher or lower than expected given the levels of these standard mortality measures. We will also present analyses for LTR indicators over time and by global region.

We believe that the proposed LTR indicators make an important contribution to adopting a life course perspective on maternal health, recognizing that the risks of pregnancy loss and adverse child health outcomes accumulate across the reproductive lifespan. They are also unique for capturing the women-level for the experience of stillbirth and neonatal loss, thereby embedding these events into broader trajectories of women's health. We are committed to using our research findings to advocate for the closer integration of the maternal and child health agendas in a post SDG era. We believe our results can help to demonstrate the intrinsic links between maternal wellbeing and stillbirth/neonatal mortality, and strengthen the case for integrating stillbirths into the global agenda post-2030.

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