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Konrad-Zuse-Strasse 1 · D-18057 Rostock · Germany · Tel +49 (0) 3 81 20 81 - 0 · Fax +49 (0) 3 81 20 81 - 202 · www.demogr.mpg.de

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Heini Väisänen
Ewa Batyra I batyra@demogr.mpg.de

This working paper has been approved for release by: Joshua Wilde (wilde@demogr.mpg.de),
Deputy Head of the Laboratory of Fertility and Well-Being.

The Effect of Birth Intention Status on Infant Mortality: A Fixed Effects Analysis of 60 countries

Heini Väisänen[1] and Ewa Batyra[2]

[1] *Institut National d'Etudes Démographiques (INED), Aubervilliers, France & University of Southampton, Southampton, UK, email: heini.vaisanen@ined.fr;*
[2]*Center for Demographic Studies, Barcelona, Spain & Max Planck Institute for Demographic Research, Rostock, Germany, email: batyra@demogr.mpg.de*

Abstract

Most studies on the impact of birth intentions on children's wellbeing do not separate the effect of pregnancy intention status from the socio-demographic characteristics associated with it. There is a lack of studies taking a multi-country comparative perspective. We analysed 60 Demographic and Health Surveys in Asia, Americas and Africa to examine the effect of birth intentions on infant mortality using sibling fixed-effects linear probability models accounting for confounding due to unobserved time-invariant family-level characteristics. Compared to wanted births, the probability of infant mortality was higher after an unwanted or mistimed birth, or both, in 44 countries. Particularly in West Africa, mostly mistimed pregnancies were associated with infant mortality, whereas in Americas unwanted pregnancies mattered more. These differences could be partly due to contextual variation in the concept and reporting of birth intentions. We show that the risk of infant mortality after an unwanted/mistimed pregnancy was higher in countries with low human development index and high overall infant mortality rate, highlighting the importance of taking context into account rather than pooling data. To the best of our knowledge, this is the first large-scale, cross-country comparative study to analyse the effect of birth intentions on infant mortality using a fixed-effects approach.

Keywords: Cross-country comparison; Fertility and childbirth; Sexual and Reproductive Health and Rights; Pregnancy Intentions; Infant Mortality.

Introduction

There is a longstanding interest in understanding the effects of pregnancy intentions on children's wellbeing among academics and policymakers. Unintended pregnancy rates have been decreasing across all world regions in the last decades, but they remain quite high especially in Africa and Latin America (around 90/1000 women and 70/1000 women, respectively, in 2015-19) (Bearak et al. 2022; Sedgh et al. 2014). Even though unintended childbearing is relatively common, systematic literature reviews highlight that its consequences in many parts of Africa, Latin America and Asia remain poorly understood and that that there is insufficient knowledge on whether the relationship between pregnancy intentions and outcomes differs across settings (Gipson et al. 2008; Hall et al. 2017).

Existing studies usually start from the premise that children born following unplanned pregnancies could be at higher risk of negative health outcomes, but the resulting empirical evidence is inconsistent. The difficulty in concluding whether pregnancy intentions are in fact important for children's outcomes stems from two limitations of the existing body of research. First, many studies on the topic suffer from the difficulty of separating the effect of pregnancy intentions status from the sociodemographic characteristics typically associated with such intentions as well as children's wellbeing (see reviews e.g. by Dibaba et al. 2013; Gipson et al. 2008). Few studies account for this unobserved heterogeneity, that is, the unobserved characteristics associated with both the predictor and the outcome, which can bias their estimates. Second, there is currently a dearth of large-scale, cross-country comparative research on the topic that could cast light on whether differences in conclusions between the existing, predominately single-country studies, are due to methodological differences, or because the effects of unintended pregnancies vary by context.

In this study, we aim to address these shortcomings. First, using a methodological approach that allows to account for unmeasured confounding, we investigate whether unintended births affect the risk of infant mortality. We use fixed-effects sibling comparison models to control for all time-invariant mother and family background characteristics. Second, by focusing on 60 countries across Asia, the Americas (excluding the US and Canada), and Africa, we aim to uncover whether the consequences of unintended births differ by country context.

By *unintended births* in this study, we mean pregnancies that ended in live births and were either not wanted at all at (*unwanted*) or were wanted later (*mistimed*) at the time of conception, which we identify based on the retrospective reports of birth intentions status. The main outcome is the risk of infant mortality, that is dying before one's first birthday. We chose infant mortality, because it is one of the key indicators used to track improvements in child and population health. Because of the undisputable importance of ending preventable early-life deaths, it is a metric that is widely collected and available, even in resource-poor contexts.

Our focus on early-life mortality is motivated not only by the fact that it is a pressing health problem featuring prominently in Sustainable Development Goals (SDGs) agenda (United Nations 2016), but also because many of the settings this paper concerns carry a particularly heavy early-life mortality burden. According to the 2020 estimates of the UNICEF's Inter-agency Group for Child Mortality Estimation, infant mortality rate for sub-Saharan Africa and Southern Asia was 51 and 31 per 1000 live births, respectively, which is around eight-to-ten times higher than in Europe and Northern America (UN Inter-agency Group for Child Mortality Estimation 2021). Given the insufficient improvements and the prospect of many LMICs failing to reach the SDGs related to child mortality reductions, there is a call for action to advance knowledge of the factors contributing to these high levels of early-life mortality. In this paper, taking a cross-country comparative perspective, we aim to rigorously explore whether, and if so, where, birth intentions matter for infant mortality. Our results will be of interest to academics and policy makers aiming to improve child health.

Background

Consequences of unintended pregnancies

Previous studies have examined whether birth intention status is associated with early-life mortality (including infant and child mortality). Such studies in Asia, Americas, and Africa have suggested, for instance, that there is no association between having a birth after expressing an intention to stop childbearing and mortality before age 3 in Matlab in Bangladesh (Bishai et al. 2015); retrospectively measured birth intention status (wanted, mistimed, unwanted) and early-life mortality in Dominican Republic, Egypt, Kenya, Philippines, or Thailand (Montgomery et al. 1997); or the London Measure of Unplanned Pregnancy (see Barrett et al. 2004) and neonatal mortality in Malawi (Hall et al. 2018). On the contrary, in India an association between being unwanted/mistimed and infant mortality was found (Singh et al. 2013). However, these studies did not use methodologies, which would disentangle whether these outcomes were due to the unintended birth itself or rather due to socio-demographic characteristics associated with both the likelihood of unintended pregnancies and the outcomes studied, although Bishai and colleagues (2015) highlighted the importance of such selection processes. Moreover, the majority did not explicitly consider mistimed pregnancies (Bishai et al. 2015; Hall et al. 2018; Singh et al. 2013).

Some studies have used analytic strategies, such as sibling fixed-effects models, to separate the effect of pregnancy intention status from the socio-demographic characteristics typically associated with such intentions as well as children's health. These models control for unobserved, stable family-level and mother's characteristics, which could otherwise bias the results. Such studies examining children's outcomes in the US found no effect of pregnancy intention status (wanted, mistimed or unwanted) on longer term risk of depression among children (Su 2017), children's weight, or cognitive development (Joyce et al. 2000).

Little is known about these associations outside of the US, particularly in a multi-country comparative perspective, which could shed light on the importance of country context for these outcomes. We found three studies in Asia or Africa (but none in the Americas outside the US) using fixed-effects models. In India, unwanted and mistimed births were associated with a higher infant mortality risk and these children were also less likely to receive immunisations (Singh et al. 2012). Chalasani et al. (2007) also documented excess infant mortality of children born as a result of unwanted pregnancy in Bangladesh, but they did not examine mistimed pregnancies. A study pooling data from 33 countries in Africa found that siblings excessing the ideal number of children in the family, the ideal number of children of that gender, or both, had an increased risk of infant mortality compared to those born at lower parities (Flatø 2018). However, they used a question about women's ideal family size (i.e., asking women to go back in time before childbearing and state their fertility preference at that time) and classified children of order higher than ideal as undesired (Flatø 2018). This approach has at least three important limitations. First, intentions prior to childbearing overall do not necessarily correspond to whether a given child was desired *at conception*, which is the key for birth outcomes and for conducting mother fixed-effects analysis. Second, this approach rests on a strong assumption that these children of order higher than ideal family size, are "in excess", which does not necessarily have to be the case if, for example, it was women's first pregnancy that was undesired. Fourth, this approach ignores mistimed pregnancies entirely. Finally, the results were not shown by country, which could mask contextual variation within the region.

Measuring pregnancy and birth intentions

There is a large body of research highlighting challenges of studying pregnancy intentions as well as the strengths and the limitations of various approaches aiming at capturing them. The main shortcoming of retrospective measures, which are most frequently used given their availability, is that they can suffer from recall bias that leads to the underestimation of levels of unintended births (Bankole and Westoff 1998; Koenig et al. 2006). Approaches aiming at capturing undesired pregnancies by defining children as "in excess" based on information about ideal family size and the number of children women has (Flatø 2018) can also be affected by ex-post realization. In fact, recent research on Malawi highlights a large degree of instability in reporting of desired fertility throughout women's life course (Müller et al. 2022). Conversely, prospective reports are not subject to recall issues, but they can be biased if women alter their fertility desires between the time they were first surveyed and when the data on pregnancies were collected (Bishai et al. 2015). Another shortcoming of prospective reports is that their availability in the regions of interest in our study is limited to country-specific surveys.

While keeping their limitations in mind, an important advantage of retrospective questions over other approaches to measuring fertility desires is that they refer to each specific birth. As such, conducting a large-scale, cross-country, and cross-regional analysis using fixed-effects, as aimed in this paper, is only possible using a retrospective pregnancy intentions measure.

An important issue that should be highlighted when studying the relationship between birth intentions and early-life mortality using retrospective questions is a potential bias in reports pertaining to deceased children. Research on sub-Saharan Africa has shown that mothers are less likely to report a child as 'unintended' (combining mistimed and unwanted) if the child has died (Smith-Greenaway and Sennott 2016). Such possible biases mean that children who died shortly after birth might be more often classified as having been wanted at the time of pregnancy than those who survive. This means that our estimates about the potentially elevated risk of infant mortality among unintended births would be conservative.

Conceptual framework

Our conceptual framework is adapted from that of Gipson and colleagues (2008), which identifies potential effects of unintended pregnancy on infant, child, and parental health outcomes, and shown in Figure 1. It displays contextual as well as individual-level factors affecting the likelihood of infant mortality following births of different intention statuses:

wanted, unwanted, or mistimed. As shown in Figure 1, there are many individual-level characteristics, which may affect both pregnancy intention status and infant mortality. Thus, it is important to use study designs, which take this heterogeneity into account.

We believe that pregnancy intention status is associated with individuals' experiences and behaviours during pregnancy, labour, and the postnatal period, which may in turn affect the probability of infant mortality. Indeed, unintended pregnancies have been shown to be associated with a smaller likelihood of giving birth with a skilled attendant in India (Chatterjee and Sennott 2020; Singh et al. 2012), and lower or later antenatal care attendance in Bangladesh, India, Ethiopia, Namibia and Iran, as well as in a multi-country study in Africa (Amo-Adjei and Tuoyire 2016; Chatterjee and Sennott 2020; Kamal et al. 2013; Khajehpour et al. 2013; Thogarapalli et al. 2016; Wado et al. 2013). In the US, unintended births were associated with heavy smoking during pregnancy (Joyce et al. 2000). In India, children born from unintended pregnancies were less likely to receive immunisations (Singh et al. 2012). While we are not able to explicitly study these experiences and behaviours here, we believe they are important in explaining the mechanism linking pregnancy intention status with infant mortality (Fig. 1).

The societal context, in which the individuals live, is also likely to impact the relationship between birth intention status and infant mortality. Norms and stigmas around fertility and sexuality may affect pregnancy intentions to begin with, as well as decisions to either abort or carry an unintended pregnancy to term (Väisänen and Batyra 2022). The wider level of 'development' of the country has been shown to affect the association between other variables, such as birth intervals and infant mortality (Molitoris et al. 2019). Thus, in addition to conducting our analyses by wider world regions, we examine how the relationship varies by country and whether it varies by levels of 'development' as measured by the overall infant mortality rate (IMR) and the human development index (HDI). These can be seen as proxies of the wider knowledge about, quality of and access to health care in each country.

In this study, our research questions are:

1. Is birth intention status associated with the risk of infant mortality?
2. To what extent does this association vary by context?

Since there are some individual-level characteristics and behaviours, which may vary over time as shown in Figure 1, which we cannot control for in our models, we do not claim being able to prove a direct causal link between pregnancy intentions and infant mortality. Nevertheless, this study goes beyond existing literature by combining the sibling fixed-effects design and an analysis of the importance of context in one study. This improves our understanding of the potential implications of unintended pregnancies and how these may vary between countries. While the sibling fixed-effects design cannot control for unobserved *time-variant* characteristics, it is superior to approaches applied in most existing studies that do not control even for unobserved *time-invariant* characteristics.

Data

We used individual women's recodes of the Demographic and Health Surveys (DHSs) that were collected in Asia, Africa and the Americas between years 2000 and 2020 and that included information on pregnancy intentions of all births that happened within a five-year period preceding the survey. We excluded surveys that collected data about ever-married women only. For each of the 60 countries covered by our analysis, we use the most recent DHS available. The list of surveys used and years in which they were collected, as well as regional groupings that follow the DHS classification of world regions, can be seen in Table 1.

Our outcome variable is *infant mortality*, which is defined as a death of a child before the age of 12 months. In detailed histories of women of reproductive age, DHSs provide information about the date of birth, and if a child died, also their exact date of death, for all children ever born. Our main explanatory variable is *pregnancy intentions* from the DHS maternity history, which classifies the intention status of each birth that happened within five years of the survey into wanted, mistimed (wanted later) or unwanted at the time of conception. This information is based on women's retrospective reports and aims to reflect their intention to have a child before becoming pregnant.

Due to our analytic strategy (see more details below), we restrict the sample to mothers (and their children), who had at least two live births within the five years preceding the survey for which their birth intention status was known. As explained above, information about intentions is not available for pregnancies that resulted in live births more than five years before the survey date. Finally, we excluded non-singleton births (i.e., twins, triplets etc.), as children born as a result of multiple pregnancy are known to differ in their characteristics, including early-life mortality (Bellizzi et al. 2018; Uthman et al. 2008), from those from singleton pregnancies. While we were only able to include a subset of observations in our analyses (around 23.8% of the 1,636,979 births recorded in the DHSs in the 5-years before each survey were included), our analytic sample did not differ much in their birth intentions or experiences of infant mortality from all women who had a birth in the last five years (Appendix table 1). The women in our analytic sample were slightly younger (28.0 vs. 31.0 years on average), but had similar levels of education as all women with at least one birth in the last five years (4.8 vs. 4.9 years of education, on average, respectively) (not shown).

We include a set of control variables that may vary between children born to the same mother. We derive variables that are available in DHSs and are known to be associated with both birth intention status and early-life mortality: mother's age at the time of birth, child's sex, and child's birth order (Adetunji 1998; Boco 2014; Coffey and Spears 2021; Finlay et al. 2011; Hussain et al. 2000; Jiang et al. 2016; Kashyap and Behrman 2020; Rutstein 2000; Titaley et al. 2008; Uddin and Hossain 2011). Unfortunately, we were not able to control for all time-invariant characteristics of interest, as comparative data are not always collected within the DHS program. For example, we have data only about current marital status; antenatal and postpartum visits are collected for the last pregnancy only; and information about breastfeeding practices is available only for children that are currently being breastfed.

Finally, we use data from two external sources to study the variation by 'development' level in the association between birth intentions and infant mortality. First, we use estimates of infant mortality rate as published by DHS in StatCompiler (Measure DHS 2022) for each country-survey that we use in this study. Second, we use Human Development Index from the United Nations Development Programme's Human Development Reports (UNDP 2022). We match the HDI value to each country based on the year the survey we use was conducted.

Methods and analytic strategy

We use sibling fixed-effects linear probability models to identify the effect of birth intention status on infant mortality using the following equation:

$$Y_{ij} = BIS_{ij}\beta_{1,ij} + \boldsymbol{X}_{ij}\beta_{k,ij} + u_j + e_{ij} \quad \text{(eq. 1)}$$

The outcome variable *Y* in equation 1 is a binary variable indicating whether child *i* to mother *j* died before their first birthday. Birth intention status (BIS) indicates whether each child *i* to mother *j* was wanted, mistimed or unwanted at the time of conception. The vector of control variables **X** includes mother's age at the time of birth, child's birth order and sex as explained in Data-section. Adding a mother-specific fixed intercept u_j controls for all time-invariant family-level factors and means that we are comparing the pregnancy intention status of siblings born to the same mother. This modelling strategy can thus be used to address the endogeneity issues arising from birth intention status being correlated with the same unobserved factors as infant mortality. Thus, our results are not affected by any time-invariant characteristics that may be correlated with both birth intention status and infant mortality.

There are some limitations with these models. For instance, we can only analyse the sub-set of mothers who had at least two births within the five years of follow-up for which the intention status is known. As such, the results cannot be generalised to *all* mothers regardless of the number of children they have had in the last five years.

After running descriptive analyses to characterise our sample, we conduct a set of fixed effects regression models (see eq. 1) first separately by DHS region[1] and then by each individual country. We ran separate analyses, as regions or countries do not vary between siblings and thus cannot be included as explanatory variables in the models. We express the results of our analyses as predicted probabilities of infant mortality by birth intention status while holding the control variables at their means. These probabilities are interpreted and discussed on their own, as well as plotted with contextual effects of interest: infant mortality rate and the HDI in each country. The plots help us better understand the way context shapes the association between birth intention status and infant mortality.

Finally, we conduct sensitivity analyses. First, we control for the preceding birth interval (in months as a continuous variable, allowing for a quadratic non-linear effect), which has been shown to be a predictor of both our main explanatory variable (Adetunji 1998) and outcome (Molitoris et al. 2019; Rutstein 2000; Titaley et al. 2008). To implement this analysis, we additionally restrict our sample to women who had at least three births, as done in previous research exploring links between birth intervals and children's outcomes using fixed-effects models (Molitoris et al. 2019). This is necessary to obtain a birth interval for all siblings of interest. The DHS provides information about birth intervals of all births, irrespectively of their timing. Thus, while we still need to focus on women who had at least two births within the five-year window prior to the survey date – to have information about the birth intention status of the two latest births – the birth of the third child (i.e., lowest order birth) could have happened at any point in time.

[1] We use DHS regions, as they typically include countries geographically and culturally relatively similar to each other. However, as some regions only included a small number of countries, we combined them into larger groups than the original DHS regions: Central and Southern Africa; South and Southeast Asia; Central and Western Asia were grouped into three groups, respectively, instead of six. While only one country from North Africa was included (Morocco), we did not group it with other regions due to lack of a sufficiently similar group of countries.

We also ran sensitivity analyses testing whether our results could have been biased by right censoring, that is, by some births having taken place less than a year before the interview date thus meaning that these children were not exposed to the risk of infant mortality as long as those who were born at least a year before the interview. To cast light on whether this issue could be influencing our results, we conducted additional analysis that included only births that happened at least a year before the interview date. Finally, we examined non-linear effects and interactions for two control variables (age and birth order) to see, whether the effect of birth intention status on the probability of infant mortality is different based on these characteristics. Non-linear effects were tested using both step-functions and polynomials.

Results

Descriptive statistics

Table 1 shows descriptive statistics for our analytical sample, which consists of children born to women who had at least two births in the five years preceding the survey (386,683 children and 184,726 women). By country, the sample sizes varied from 604 children in Armenia to 21,233 in Nigeria. Overall, infant mortality, defined as percentage of children who died before the first year of life, was lowest in Central & West Asia (2.8%), followed by Central and South America (~4%). Infant mortality was highest in Africa, and its western parts in particular (6.1%). At country level, the lowest level of infant mortality was reported in Armenia (0.7%) and the highest in Sierra Leone (8.7%). There was substantial variation in the percentage of births reported as mistimed and unwanted across the regions. By region, women tend to report fewer mistimed births in Central and West Asia (3.4%) compared to other areas, whereas on average the lowest proportion of unwanted births were reported in West Africa (2.7%). In all African regions, women tend to report births as unwanted much less frequently than as mistimed. Women in the Americas reported a relatively high proportion of both mistimed and unwanted births (>20%). The highest level of mistimed and unwanted births in our dataset is found in Namibia (~40%) and Bolivia (41.7%), respectively. The lowest levels were found in Timor-Leste (2.4% for mistimed births) and Kyrgyzstan (0.2% for unwanted births) (Table 1).

Figure 2 shows the percentage of births in our analytic sample where the infant died before their first birthday, by birth intentions status. These bivariate associations between birth intention status and infant mortality provide evidence of large variations between regions and countries. While in the majority of Central & South African countries the percentage of children who die before the first year of life is generally higher for mistimed and unwanted births, as compared to wanted ones, the opposite tends to be the case in most West and East African countries. Nonetheless, there is substantial variation within regions. For example, in Central & South Africa, a higher percentage of mistimed than wanted pregnancies was followed by infant death in Congo, but the association reversed in Gabon. The results for specific countries in the Americas and Asia are also quite mixed.

Sibling fixed effects

Figures 3 to 5 show predicted probabilities of infant mortality by birth intention status and world region or country (see also Appendix Table 2). The probabilities were calculated based on our fixed effects linear probability models holding woman's age at the time of birth, the child's birth order and sex at their means. Before running these final models, we included the control variables separately first starting from a model with birth intention status only, then adding mother's age at birth, birth order of the child, and finally child's sex, respectively (not shown, available on request). We found that the differences between unintended (unwanted/mistimed) and wanted pregnancies generally became more pronounced as variables were added thus suggesting that the control variables might work in an opposite direction to birth intention status variable in predicting the probability of infant mortality.

Figure 3 shows that in all regions the probability of infant mortality was the lowest for wanted births. However, among unplanned births the direction of the association varied. Unwanted pregnancies had the highest point estimates of infant mortality in Central and Southern Americas, Central and Western Asia and East Africa, whereas in West, Central and Southern Africa as well as South & Southeast Asia this was the case for mistimed pregnancies. The lowest probability for infant mortality was observed among wanted births in Southern America (1.2%) and the highest for mistimed pregnancies in West Africa (9.6%).

The picture gets more nuanced when individual countries are examined (Fig.s 4 and 5). In 16 countries out of the 57 retained in the country-level regression models[2], both mistimed and unwanted births had a higher probability of infant mortality than wanted births, whereas in 21 countries only mistimed pregnancies were significantly different, in six unwanted only and in 14 countries neither.

[2] Armenia, Kyrgyzstan, and Tajikistan were not included at country-level due to the small number of unintended births observed, although they were retained in the regional analyses above.

In Central and West Asia mistimed pregnancies did not differ from wanted ones, but the probability of infant mortality was higher for unwanted births in Turkey. In South and Southeast Asia, the picture was more varied: in four countries both unwanted and mistimed births had a higher probability of infant mortality than wanted births (Cambodia, India, Indonesia and the Philippines), in two no differences were found (the Maldives and Timor-Leste), and in one each either unwanted (Myanmar) or mistimed pregnancies (Nepal) differed from wanted ones (Fig. 4, panel a).

In the Americas, in many countries (Colombia, Dominican Republic, Guyana, Nicaragua and Peru) probability of infant mortality did not differ by birth intention status. In Bolivia, Guatemala and Honduras, infant mortality was more likely among unwanted births, and in Haiti among both unwanted and mistimed births (Fig. 4, panel b)

In West Africa, the probability of infant mortality was often higher for mistimed births than wanted ones, but no difference was detected for unwanted births. This pattern was also found for nine other African countries in other regions of the continent. In the vast majority of the remaining African countries both unwanted and mistimed births were significantly different from wanted ones. The exceptions were Chad, Comoros, Congo (Brazzaville), Mauritania, Sao Tome & Principe and Sierra Leone, where no differences were found, and Madagascar, where only unwanted pregnancies differed (Fig. 5).

Contextual factors

We examined whether the association between birth intention status and infant mortality varied by contextual characteristics of interest: countries' level of infant mortality (IMR, Fig. 6) and human development index (HDI, Fig. 7). We show results overall for all countries, including the linear fit, and the color-coded points by region. In line with results from the previous section, predicted probabilities of infant mortality are generally higher for mistimed and unwanted births, as compared to wanted ones (Fig. 6 and 7). The predicted probability of infant mortality increases with countries' IMR (Fig. 6) and decreases with countries' HDI level (Fig.7). These relationships are visible across all birth intention status groups, but they are the strongest for mistimed births (the steepest slope). These results suggest a particularly heavy mortality burden associated with mistimed pregnancies, which is magnified in the contexts characterized by high early-mortality and low HDI levels. Overall, children born following mistimed and unwanted pregnancies are disadvantaged when it comes to survival, and for mistimed births, this disadvantage is even larger in less ‘developed’ settings.

Sensitivity analyses

We ran a number of sensitivity analyses to ensure the robustness of our results. First, we examined whether the length of the preceding birth interval (and its quadratic effect) might explain our results especially pertaining to mistimed pregnancies, which are more likely to have taken place after a short interval. This is important, as short birth intervals are associated with a higher risk of infant mortality (Molitoris et al. 2019). The results are not fully comparable to those presented in Figures 3-5 and Appendix Table 2, as we had to restrict the sample to only those women who had at least three births (to retain at least two birth intervals, see Molitoris et al. 2019). As a result, we were able to include 79% of births of our analytic sample.

The point estimates were very similar in both models (with and without birth intervals), but significance levels changed for some countries: 25 out of the 43 nations where significant effect was initially found still had significant effects (see Appendix tables 2 and 3). In most world regions, there were one to three countries each, where significant differences had been found in the original model, but this was no longer the case in the birth interval model. Only in the Americas, all four countries that had significant effects in the original model, no longer did so in the birth interval model, meaning that in none of the countries there was a link between birth intention status and early mortality once birth intervals were accounted for (Appendix Table 3).

These changes are likely partly due to the decline in sample size in the birth interval analysis, and partly due to birth interval explaining a proportion of the associations we initially found. Moreover, there is undoubtedly overlap in what the birth interval and mistimed variables measure, as mistimed births are those that happened earlier than expected, meaning that their birth intervals were likely shorter. Nevertheless, given that the birth interval sensitivity analysis provided similar results as the original model and given that our original model was able to include a larger and more diverse sample, we retained it as the main one. The sensitivity analysis is nonetheless important as it highlights that birth intervals alone cannot explain our results. This provides strong evidence that birth intendedness does matter in addition to any effect linked to birth spacing.

Next, we run the same analysis as shown in Figures 3-5 and Appendix Table 2, but only including births that took place at least a year before the interview date (Appendix Table 4).

We were able to include 79% of the births from our analytic sample in this analysis. The point estimates (see Appendix Table 4) were very similar to those presented in Appendix Table 2. This result is not unexpected, because infant mortality tends to be concentrated to the first few days and weeks of life (Preston et al. 2001) and thus the shorter exposure of more recent births only has a minimal impact on the results. In terms of significance, there were 21 countries where no significant effects by birth intention status were found in the more restrictive model, as compared to 14 in the original one. As in the birth interval analysis, this could partially be due to smaller sample sizes.

Finally, we tested for interactions and non-linear effects first using step-functions (one-year or one-child intervals), but as the results suggested linear or at most quadratic effects, we settled for second order polynomial effects (not shown, available on request). Even then, the polynomial effects were rarely significant (in 5 countries for age; and 12 countries for birth order) and neither were the interactions with birth intention status (in 3 countries for age and 4 for birth intention status) (not shown, available on request). Most importantly, the point estimates for birth intention status including either a linear or a polynomial effect for age and birth order (not shown, available on request) were very similar to the estimates for birth intention status shown in Appendix Table 2. As such, we chose the simpler model with linear effects and no interactions.

Discussion

To the best of our knowledge, this is the first cross-country comparative study to analyse the effect of pregnancy intention status on infant mortality comparing a large number of countries in several world regions and using fixed-effects models. Most previous studies on the topic have focused on a single nation, the United States and India being the most popular choices. Furthermore, unlike many previous studies, we differentiate between mistimed and unwanted pregnancies rather than analysing them as one group.

Birth intentions matter when controlling for unobserved characteristics

Our results highlight the importance of accounting for unobserved family-level and women's characteristics when studying the relationship between pregnancy intentions and health and well-being of mothers and their children. The associations identified in the bivariate analyses, which do not take into account family-level and women's characteristics, were very different from those suggested by the fixed-effect models that account for these characteristics. While the bivariate analyses indicated that in many nations unintended pregnancies were associated with lower infant mortality than wanted pregnancies (with the exception of most West African countries), fixed-effects results differed. In none of the countries did the analysis accounting for unobserved heterogeneity indicate that mistimed or unwanted pregnancies had a statistically significantly lower probability of infant mortality than wanted pregnancies. On the contrary, in 43 countries out of the 57 retained in the regression analyses, a significant positive effect, i.e., higher probability of mortality, was found for at least one category of unintended pregnancy as compared to wanted pregnancies.

Our findings showing that children born as a result of mistimed and/or unwanted pregnancies had an increased probability of dying in infancy, are consistent with the results of studies that employed fixed-effect models in India and Bangladesh, where mortality risk also increased for unintended births (Chalasani et al. 2007; Singh et al. 2012).

The effects of mistimed and unwanted births differ

Interestingly, our results suggest that in some sub-regions, in Africa and its Western part in particular, mistimed births were associated with a higher risk of infant mortality in a larger number of countries than unwanted births. This is a novel finding, as previous studies that separated the effect of the two found the consequences of unwanted pregnancies to be similar to or more severe than those of mistimed pregnancies. In the abovementioned study on India (Singh et al. 2012), mistimed and unwanted pregnancies carried a similarly elevated early-mortality burden, as compared to wanted births (which is corroborated in our results for this country). On the other hand, in studies on the US, mistimed pregnancies tended to have fewer negative consequences than unwanted births (D'Angelo et al. 2004; Kost and Lindberg 2015).

Our results showing that, in some contexts, it is mistimed pregnancies that are associated with the greatest risk of adverse outcomes, suggest that it is important to distinguish between the detailed categories of pregnancy intentions. In addition, there are no obvious patterns of association when mistimed and unwanted births are compared across a diverse set of regions and countries.

The heterogeneity in the effects of mistimed and unwanted pregnancies across countries and regions could partly be due to the concept of mistimed and unwanted pregnancy varying between contexts, birth intervals being shorter for mistimed pregnancies (although our sensitivity analyses showed that birth intervals cannot fully explain the association), or the fact that, overall, more mistimed than unwanted births were reported in some of the settings, where mistimed pregnancies were linked with the highest probability of infant mortality.

We showed that mistimed pregnancies were more common than unwanted ones mainly in Africa. This may be, as women in Africa tend to have higher ideals regarding their family size than in Asia or Latin America (Bongaarts and Casterline 2013). African fertility transition may also be distinct from those observed in other parts of the world in that it has been driven mainly by birth postponement rather than fertility limitation (Moultrie et al. 2012). This uniqueness of the continent with respect to fertility spacing and stopping behaviour could explain lower levels of reporting of unwanted pregnancies, and stronger negative effects of mistimed rather than unwanted pregnancies.

The effect of birth intention status varies by context

Overall, our results highlight that the relationships between pregnancy intentions and health outcomes found in one setting are not necessarily generalizable to other contexts and underscore a need for more comparative studies. Even though we documented negative effects of unwanted and/or mistimed pregnancies in many countries, there were 14 countries with no association between birth intention status and infant mortality[3]. Future studies could focus on policy analyses and more detailed contextual examination of these countries compared to those, where an effect was found. This could potentially reveal important good practices and give clues to policy makers elsewhere as to how to break the link between unintended pregnancies and higher infant mortality in their respective contexts.

Regarding contextual factors, we show that the context in which the individuals live is shaping the relationship between birth intention status and infant mortality. Specifically, in settings with low levels of 'development', which we proxied with IMR and HDI, children born as a result of unintended, and most notably, mistimed pregnancy, are at a particularly high risk of dying early in life. This means that settings where women are likely to have lower knowledge about and

[3] These were Comoros in East Africa; Sierra Leone and Mauritania in West Africa; Chad, Congo, and Sao Tome & Principe in Central/Southern Africa; Nicaragua, Dominican Republic, Peru, Guyana, and Colombia in the Americas; and Azerbaijan, Timor-Leste, and Maldives in Asia.

access to quality health care (which IMR and HID proxy), unintended pregnancies are much more consequential for child survival.

While our analysis was confined to two general and widely available measures to describe the context, future studies could explore other contextual dimensions and, apart from between-country analysis, conduct within-country examinations that could help explain the variation in the associations that we documented. It would also be relevant to investigate, using the methodology applied in this paper, whether and where pregnancy intentions matter for other outcomes related to children's as well as mother's well-being. While in this study we focused solely on infant mortality, not least because of availability of comparable data for a large number of countries, it would be equally relevant to investigate impacts on children's health later in life as well as maternal outcomes for countries where the necessary data exist.

Strengths and limitations

The main strengths of this study involve the examination of the effects of pregnancy intentions on infant mortality for a large number of countries while taking into account any time-invariant factors associated with both infant mortality and pregnancy intentions, paying particular attention to the variation between mistimed and unwanted births, and casting light on the relevance of context and contextual factors.

The limitations of the study are closely related to data and measurement. First, the sample sizes in some of the individual countries were relatively small, which compromised the statistical power of these country-specific analyses. Second, as discussed earlier, prospective measures of pregnancy intentions may suffer from ex-post rationalisation and recall bias. This may be a particular issue for children, who later died (see Smith-Greenaway and Sennott 2016), but given that women tend to be less likely to report these births as unwanted, it makes our estimates conservative. Third, while our analytic strategy was able to account for any time-invariant unobserved characteristics, there may be unobserved time-variant characteristics, such as selection into which unintended pregnancies are aborted rather than carried to term (Bishai et al. 2015; Väisänen and Batyra 2022), which we were not able to control for. Yet, our analytic strategy is more robust than in the vast majority of previous studies as a large part of selection is nevertheless controlled for. Future studies should collect prospective longitudinal cross-country comparable data to overcome these challenges. We believe that despite these challenges, the many strengths of our study mean it still makes an important contribution to literature.

Conclusions

Our study shows that pregnancy intentions matter for the risk of infant mortality in that generally unwanted and/or mistimed births had a higher risk of mortality. However, the size of the effect and the type of intention (unwanted or mistimed) that matters the most depends on context. These results were robust to various sensitivity analyses. Overall, in contexts with high levels of infant mortality rates and low levels of HDI these effects were more pronounced. Our study uses a more robust analytic strategy than most other previous studies on the topic, taking into account unobserved time-invariant mother/family-level characteristics, which might be associated with both the outcome and pregnancy intentions. The results highlight the importance of conducting the analyses at the very least on country-level rather than by region to better understand contextual differences. It is equally important to separate between unwanted and mistimed births, as they might have different associations with infant mortality depending on context.

Our results highlight the importance of reproductive justice and autonomy (Roberts 2015; Ross 2020; Senderowicz 2019; Senderowicz and Maloney 2022). Being able to decide freely and without coercion when and if to have children, as well being able to choose freely, with enough information and without coercion, how to reach these goals is key. While there will always be unplanned pregnancies, some of which are positive surprises, people need access to the entire range of sexual and reproductive services, including family planning, medically assisted reproduction, and safe abortion services, so that they can make their choices about childbearing along the lines of the principles of reproductive justice and autonomy.

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Tables

Table 1 Distributions of the main variables in the analytic sample, % and N.

		Infant mor-tality, %	Infant mor-tality, N	Mis-timed, %	Mis-timed, N	Un-wanted, %	Un-wanted, N	N Childre n	N Women
Africa East	**DHS year**	5.0	3261	24.0	15771	6.6	4156	66101	31686
Burundi	2016-17	4.8	378	26.4	2207	7.5	580	8124	3902
Comoros	2012	3.4	62	26.6	509	6.3	135	1872	884
Ethiopia	2016	5.2	326	17.7	697	7.4	256	6078	2841
Kenya	2014	4.6	219	24.9	1171	9.8	425	5143	2437
Madagascar	2008-09	4.9	354	7.5	537	4.1	282	6905	3264
Malawi	2015-16	5.3	357	30.2	2094	9.3	619	6725	3331
Mozambique	2011	6.0	380	8.9	657	2.0	167	6122	2982
Rwanda	2019-20	4.2	144	31.7	1070	12.5	432	3437	1671
Tanzania	2015-16	4.5	241	29.9	1704	3.9	187	5553	2638
Uganda	2016	4.4	410	33.3	3039	8.4	757	9255	4371
Zambia	2018	5.2	238	30.9	1429	3.7	170	4612	2246
Zimbabwe	2015	7.1	152	29.7	657	5.5	146	2275	1119
Africa West		6.1	5083	12.7	10530	2.7	2277	84351	40797
Benin	2017-18	5.3	411	17.9	1412	5.1	409	7888	3843
Burkina Faso	2010	6.7	568	6.4	548	1.1	90	8368	4135
Gambia	2019-20	4.2	207	18.7	778	1.4	70	4574	2226
Ghana	2014	5.0	134	23.9	569	6.7	163	2705	1319
Guinea	2018	7.2	289	10.6	458	2.5	124	4216	2049
Ivory Coast	2011-12	6.9	282	20.0	778	3.2	112	3966	1948
Liberia	2019-20	7.7	209	29.5	702	6.9	184	2477	1204
Mali	2018	5.6	340	12.4	701	2.3	135	6265	2966
Mauritania	2000-01	7.4	175	24.4	696	6.0	161	2727	1316
Niger	2012	4.5	384	9.0	776	0.5	54	8625	4130
Nigeria	2018	6.8	1442	7.5	1587	1.8	405	21233	10109
Senegal	2018	3.3	129	14.7	503	2.3	72	3577	1751
Sierra Leone	2019	8.7	349	8.5	353	3.2	129	4338	2123
Togo	2013-14	4.8	164	22.0	669	5.5	169	3392	1678
Africa central & south		5.4	2885	21.5	11517	5.1	2793	54741	25857
Angola	2015-16	4.6	401	26.3	2294	4.4	400	9409	4363
Cameroon	2018	5.1	304	16.5	978	3.4	219	5592	2622
Chad	2014-15	6.6	817	10.2	1169	0.9	118	13097	6154
Congo	2011-12	3.8	201	24.1	1160	2.7	138	4942	2400
DRC	2013-14	5.2	681	22.9	2754	4.1	527	12723	5927
Gabon	2012	3.6	112	36.8	1185	5.3	191	3208	1545
Lesotho	2014	8.4	83	32.2	306	21.8	203	956	472
Namibia	2013	4.7	89	40.8	725	9.6	207	1875	918
Sao Tome &…	2008-09	2.8	24	35.8	295	18.5	140	835	424
South Africa	2016	6.1	58	32.9	306	24.4	217	893	440
Eswatini	2006-07	9.3	115	27.7	345	36.5	433	1211	592
Africa North									
Morocco	2003-04	5.1	125	20.7	484	13.2	329	2460	1193
Americas central		4.0	658	27.4	4511	20.2	3430	16601	7959
Dominican R.	2013	3.1	49	35.4	465	14.8	173	1342	646
Guatemala	2014-15	3.4	174	24.2	1310	15.4	822	5277	2529
Haiti	2016-17	7.2	170	28.8	725	27.4	735	2624	1269
Honduras	2011-12	3.1	133	33.6	1302	15.7	623	3979	1924
Nicaragua	2001	3.9	132	21.6	709	30.5	1077	3379	1591
Americas south		4.2	416	29.2	3235	32.7	3683	11202	5391
Bolivia	2008	6.3	228	25.6	1043	41.8	1592	3995	1899

Colombia	2015	2.9	88	32.3	1015	26.3	990	3238	1559
Guyana	2009	2.8	21	24.2	200	18.9	219	1006	486
Peru	2012	2.6	79	33.5	977	29.2	882	2963	1447
Asia south & southeast		5.1	7442	5.7	8232	4.7	6294	144907	68834
Cambodia	2014	4.3	91	13.0	274	6.0	124	2301	1126
India	2015-16	5.3	6688	4.8	6072	4.3	5015	124965	59278
Indonesia	2017	4.3	195	12.9	597	8.8	332	4509	2202
Maldives	2016-17	2.6	22	25.0	194	9.5	67	801	393
Myanmar	2015-16	7.1	112	4.5	80	6.4	74	1686	799
Nepal	2016	5.4	106	12.7	243	6.9	139	1897	911
Philippines	2017	2.4	101	16.9	688	11.5	465	4613	2185
Timor-Leste	2016	3.0	127	2.4	84	2.2	78	4135	1940
Asia central & west		2.8	240	6.6	569	3.4	335	8780	4202
Armenia	2015-16	0.7	5	9.2	53	0.5	2	604	298
Azerbaijan	2006	4.8	50	12.8	134	6.5	72	1098	530
Kyrgyzstan	2012	3.1	70	4.1	84	0.2	6	2212	1068
Tajikistan	2017	2.7	96	3.0	115	1.4	58	3528	1661
Turkey	2013	1.4	19	15.7	183	13.5	197	1338	645

Notes: Sao Tome &...= Sao Tome and Principe; Dominican R.= Dominican Republic.

Figures

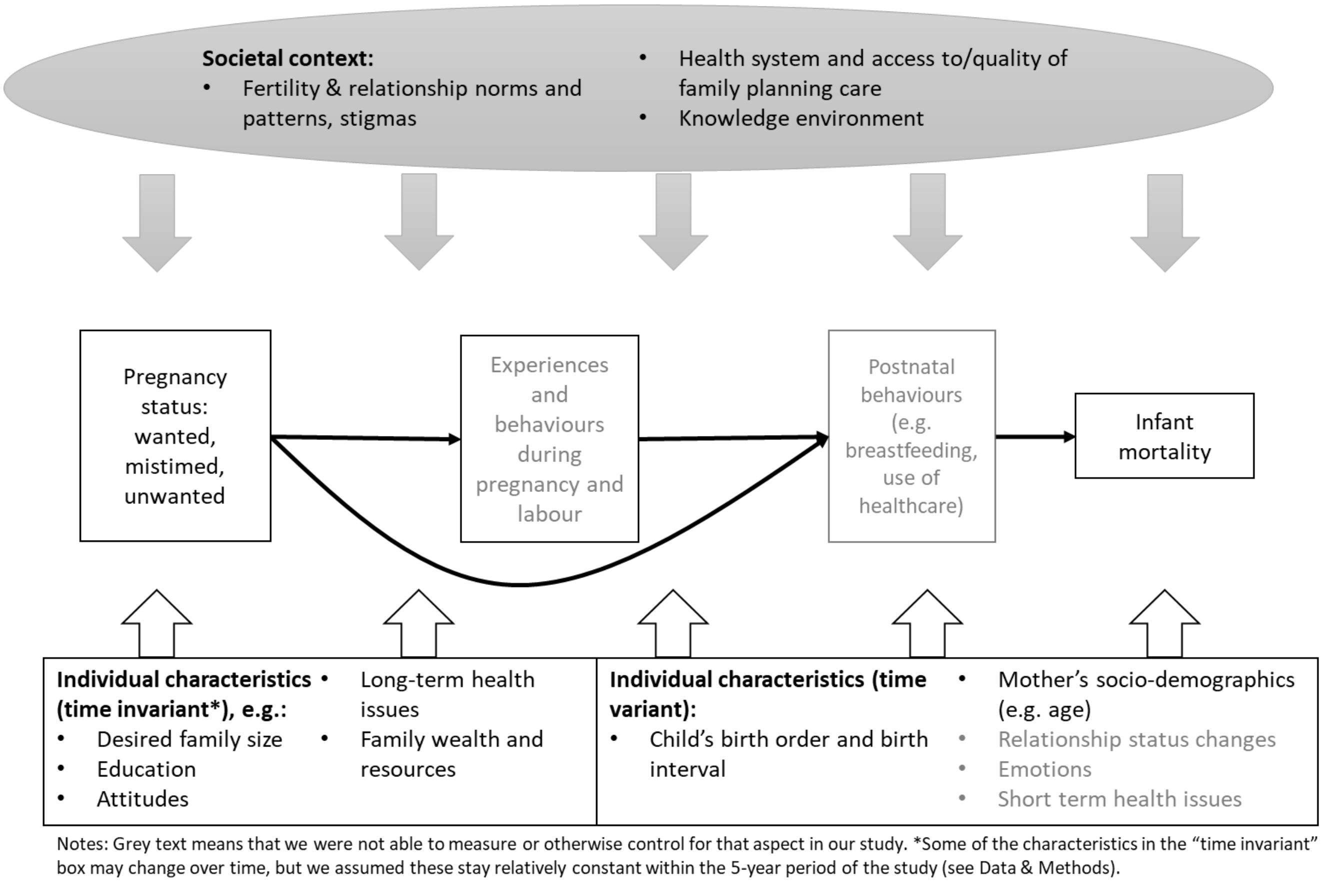

Figure 1 Conceptual framework: pathways from birth intentions to infant.

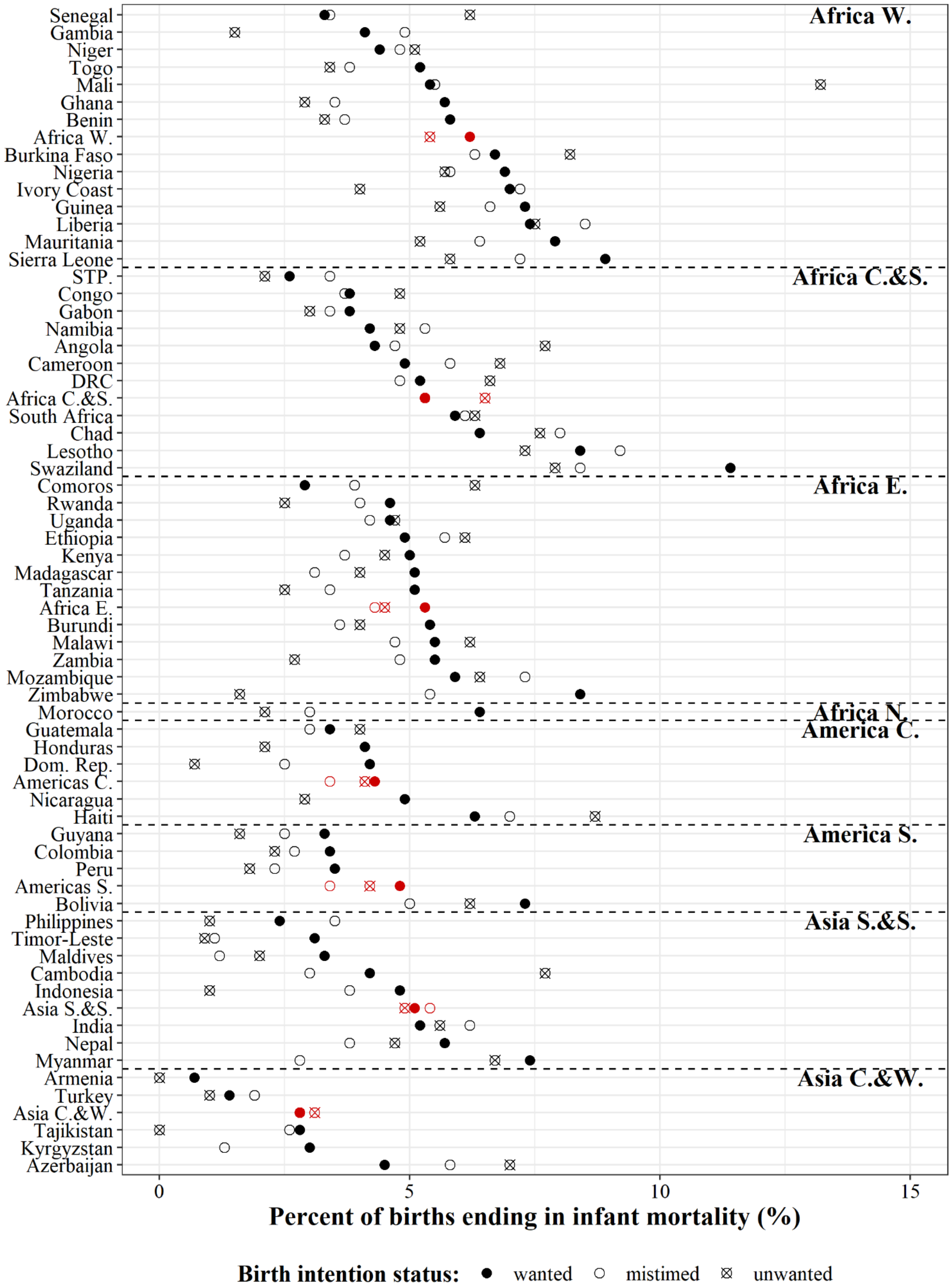

Figure 2 Infant mortality by birth intention status in each country and by region, ordered by infant mortality of wanted births within each region.

Note: Value for Kyrgyzstan for unwanted births was beyond the plot scale and was excluded (51.5%). Regional values marked with red colour.

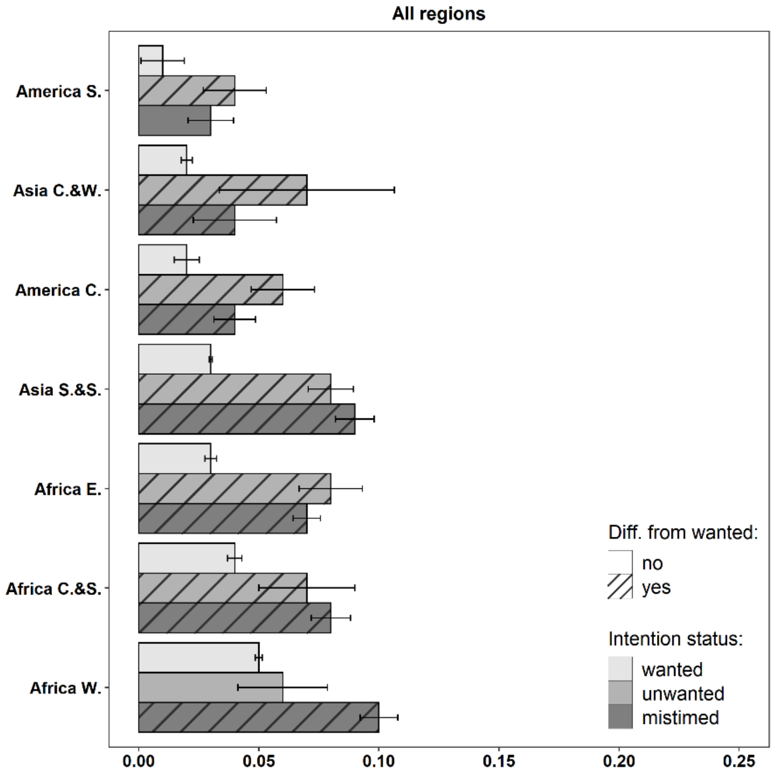

Figure 3 Probability of infant mortality by birth intention status and world region. Predicted probabilities with 95% confidence intervals.

Notes: mother's age, birth order and child's sex fixed at means. Ordered by the probability of infant mortality for wanted pregnancies. C = Central; E = East; S = South(ern); W = West; S & S = South and Southeast. See Appendix Table 2 for full results.

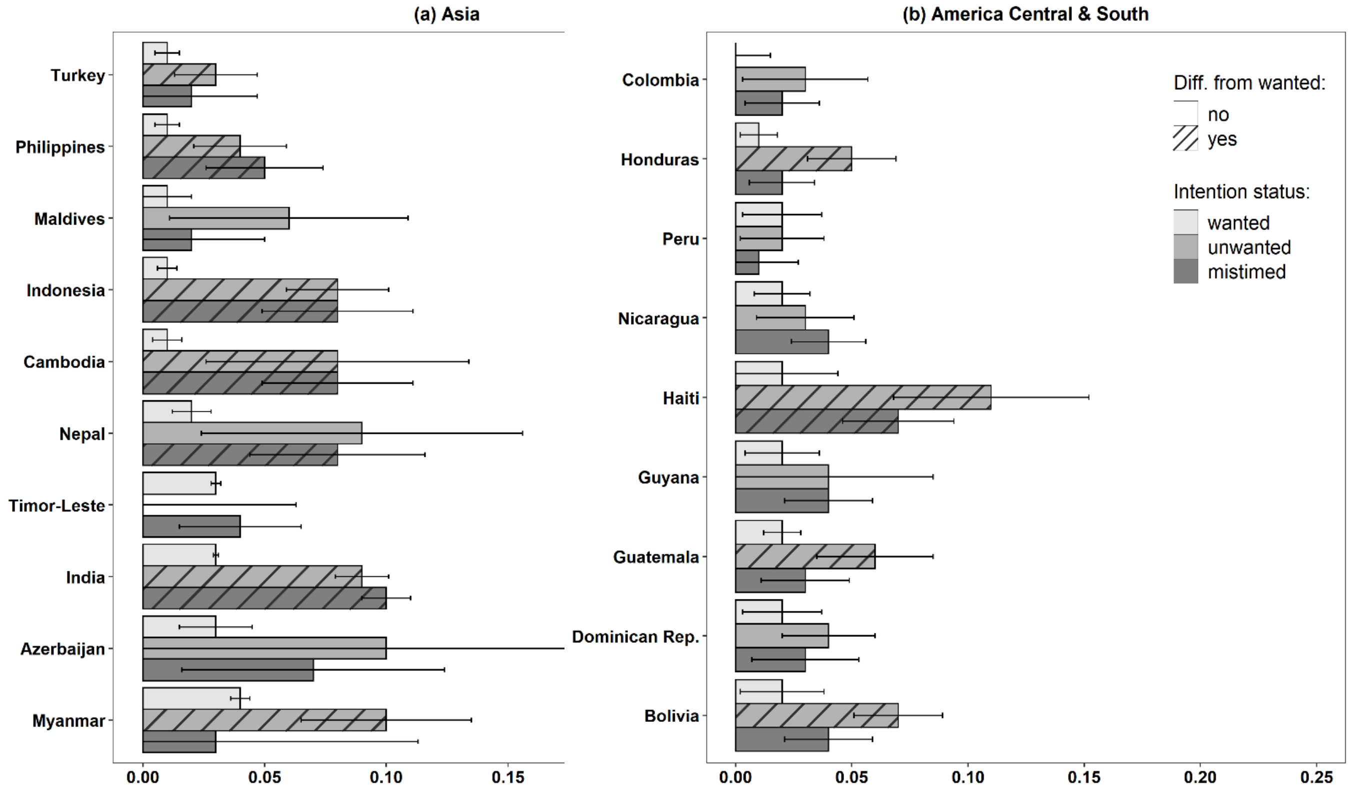

Figure 4 Probability of infant mortality by birth intention status and country in Asia and the Americas. Predicted probabilities with 95% confidence intervals.

Notes: mother's age, birth order and child's sex fixed at means. Ordered by the probability of infant mortality for wanted pregnancies. Armenia, Kyrgyzstan, and Tajikistan dropped from country-level analysis (but retained in the region-level in Fig 3) due to a low number of unintended pregnancies reported. See Appendix Table 2 for full results.

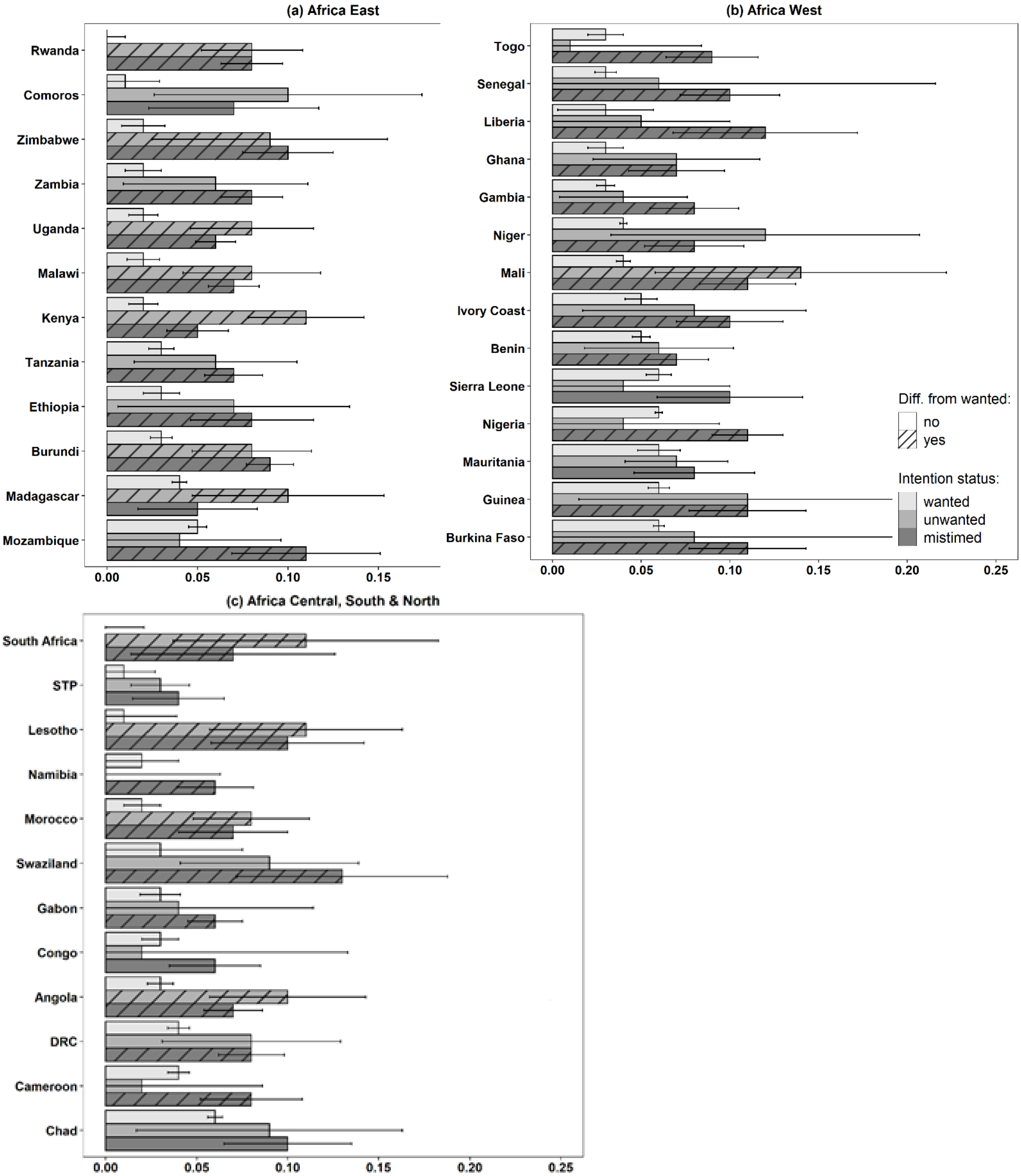

Figure 5 Probability of infant mortality by birth intention status and country in Africa. Predicted probabilities with 95% confidence intervals.

Notes: mother's age, birth order and child's sex fixed at means. Ordered by the probability of infant mortality for wanted pregnancies. DRC = Democratic Republic of the Congo; STP = Sao Tome & Principe. See Appendix Table 2 for full results.

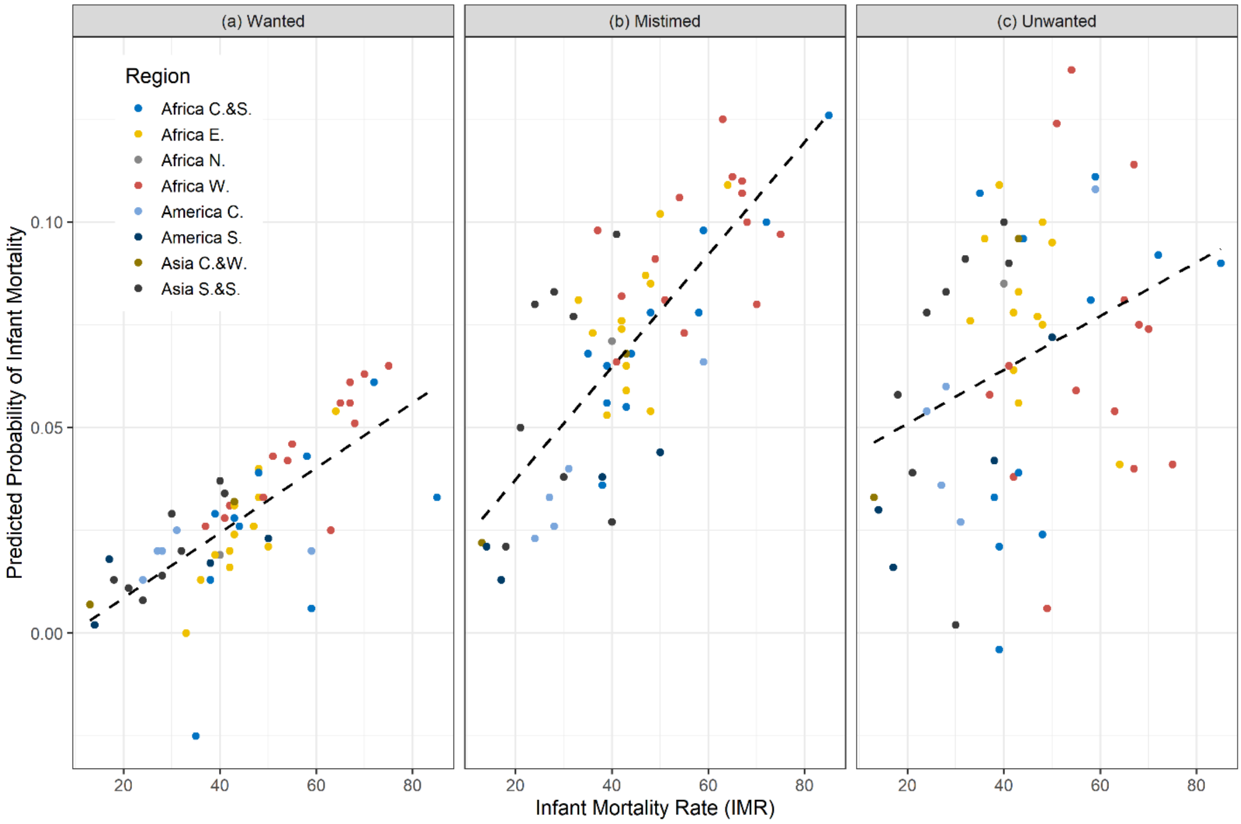

Figure 6 Probability of infant mortality by infant mortality rate of each country, results from fixed effects models. Linear fit (dashed black lines).

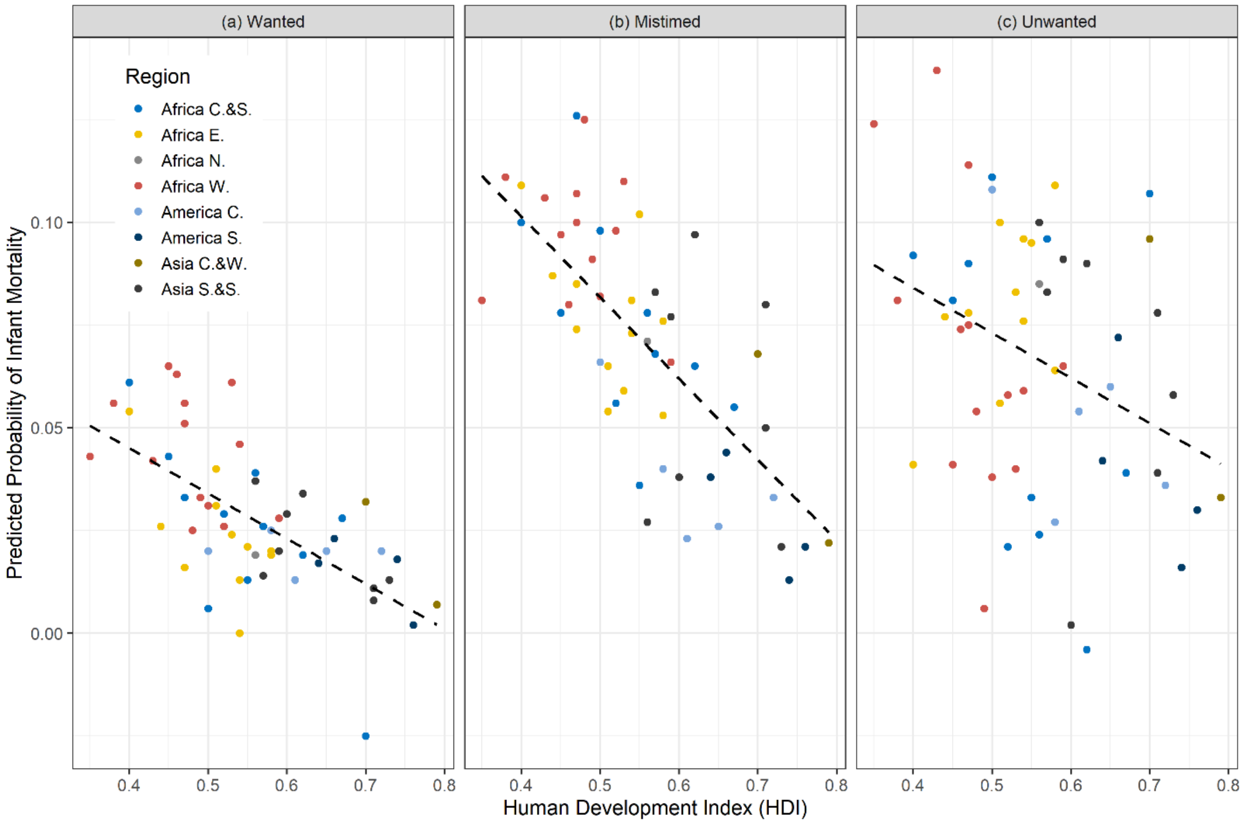

Figure 7 Probability of infant mortality by human development index (HDI) of each country, results from fixed effects models. Linear fit (dashed black lines).

Appendix

Appendix Table 1 Infant mortality and birth intention status among all women with a birth in the last 5 years vs. our analytic sample.

All women with a birth	**Infant mortality, %**	**Infant mortality, N**	**Mistimed, %**	**Mistimed, N**	**Unwanted, %**	**Unwanted, N**	**Births, N**
Africa East	5.2	16,350	23.1	29,285	7.7	9,545	321540
Africa West	6.3	22,408	13.0	18,958	3.3	4,953	354468
Africa central & south	6.0	11,894	22.9	20,839	6.8	6,303	205454
Africa North	5.2	768	14.7	863	15.2	934	14322
Americas central	3.7	3,077	25.6	10,297	18.2	7,438	84856
Americas south	3.6	2,303	27.6	8,920	26.2	8,736	65476
Asia south southeast	4.8	27,368	4.8	15,034	4.9	14,855	558336
Asia central west	3.0	975	5.2	947	4.5	894	32527
Analytic sample only							
Africa East	5.0	3,261	24.0	15,771	6.6	4,156	66101
Africa West	6.1	5,083	12.7	10,530	2.7	2,277	84351
Africa central & south	5.4	2,885	21.5	11,517	5.1	2,793	54741
Africa North	5.1	125	20.7	484	13.2	329	2460
Americas central	4.0	658	27.4	4,511	20.2	3,430	16601
Americas south	4.2	416	29.2	3,235	32.7	3,683	11202
Asia south southeast	5.1	7,442	5.7	8,232	4.7	6,294	144907
Asia central west	2.8	240	6.6	569	3.4	335	8780

Appendix Table 2 Coefficients of FE regressions controlling for mom's age, birth order, and child's sex. Reference category for birth intentions: wanted births.

Birth intentions	Mistimed	p-value	Unwanted	p-value
Africa East	0.05	0.000	0.05	0.000
Burundi	0.06	0.000	0.05	0.008
Comoros	0.06	0.072	0.08	0.060
Ethiopia	0.05	0.012	0.04	0.243
Kenya	0.03	0.005	0.09	0.000
Madagascar	0.01	0.457	0.06	0.038
Malawi	0.06	0.000	0.06	0.006
Mozambique	0.06	0.018	-0.01	0.679
Rwanda	0.08	0.000	0.08	0.000
Tanzania	0.03	0.002	0.03	0.301
Uganda	0.03	0.000	0.06	0.004
Zambia	0.06	0.000	0.04	0.120
Zimbabwe	0.08	0.000	0.07	0.047
Africa West	0.05	0.000	0.01	0.158
Benin	0.03	0.013	0.01	0.560
Burkina Faso	0.06	0.003	0.02	0.675
Gambia	0.05	0.001	0.01	0.719
Ghana	0.04	0.039	0.04	0.171
Guinea	0.05	0.009	0.06	0.252
Ivory Coast	0.05	0.012	0.02	0.478
Liberia	0.10	0.014	0.03	0.334
Mali	0.06	0.000	0.10	0.029
Mauritania	0.02	0.457	0.01	0.561
Niger	0.04	0.015	0.08	0.072
Nigeria	0.05	0.000	-0.02	0.449
Senegal	0.07	0.000	0.03	0.697
Sierra Leone	0.03	0.182	-0.02	0.452
Togo	0.06	0.001	-0.03	0.514
Africa central & south	0.04	0.000	0.04	0.001
Angola	0.04	0.000	0.07	0.004
Cameroon	0.04	0.027	-0.02	0.666
Chad	0.04	0.054	0.03	0.414
Congo	0.03	0.110	-0.01	0.905
DRC	0.03	0.004	0.04	0.151
Gabon	0.03	0.038	0.01	0.788
Lesotho	0.09	0.005	0.11	0.005
Namibia	0.05	0.022	-0.02	0.543
Sao Tome and Principe	0.02	0.291	0.02	0.176
South Africa	0.09	0.041	0.13	0.009
Swaziland	0.09	0.032	0.06	0.191
Africa North				
Morocco	0.05	0.008	0.07	0.001
Americas central	0.02	0.016	0.04	0.000
Dominican Republic	0.01	0.531	0.02	0.334
Guatemala	0.01	0.604	0.04	0.010
Haiti	0.05	0.024	0.09	0.006
Honduras	0.01	0.363	0.04	0.001
Nicaragua	0.02	0.202	0.00	0.891
Americas south	0.01	0.091	0.03	0.005
Bolivia	0.02	0.177	0.05	0.007
Colombia	0.02	0.198	0.03	0.177
Guyana	0.02	0.199	0.02	0.424
Peru	0.00	0.782	0.00	0.895
Asia south southeast	0.06	0.000	0.05	0.000
Cambodia	0.07	0.000	0.07	0.023
India	0.06	0.000	0.06	0.000

Indonesia	0.07	0.000	0.07	0.000
Maldives	0.01	0.697	0.04	0.122
Myanmar	-0.01	0.819	0.06	0.001
Nepal	0.06	0.008	0.07	0.058
Philippines	0.04	0.008	0.03	0.010
Timor-Leste	0.01	0.523	-0.03	0.408
Asia central west	0.03	0.007	0.05	0.009
Armenia [a]				
Azerbaijan	0.04	0.284	0.06	0.335
Kyrgyzstan [a]				
Tajikistan [a]				
Turkey	0.02	0.344	0.03	0.018

Notes: (a) Dropped from country-level analysis due to a low number of unintended pregnancies reported, but included in the region-level analysis.

Appendix Table 3 Coefficients of FE regressions controlling for birth interval and its quadratic effect, mom's age, birth order, and child's sex. Reference category for birth intentions: wanted births.

Birth intentions	Mistimed	p-value	Unwanted	p-value
Africa East				
Burundi	0.06	0.000	0.05	0.022
Comoros	0.08	0.059	0.12	0.032
Ethiopia	0.05	0.041	0.07	0.042
Kenya	0.04	0.011	0.09	0.000
Madagascar	-0.01	0.644	0.05	0.140
Malawi	0.06	0.000	0.05	0.054
Mozambique	0.04	0.163	-0.05	0.134
Rwanda	0.11	0.000	0.11	0.000
Tanzania	0.03	0.043	0.01	0.808
Uganda	0.03	0.002	0.05	0.011
Zambia	0.06	0.000	0.04	0.356
Zimbabwe	0.12	0.000	0.07	0.094
Africa West				
Benin	0.04	0.006	0.01	0.557
Burkina Faso	0.05	0.030	0.02	0.702
Gambia	0.04	0.028	-0.02	0.484
Ghana	0.07	0.004	0.05	0.110
Guinea	0.04	0.086	0.04	0.479
Ivory Coast	0.04	0.099	0.00	0.989
Liberia	0.09	0.101	0.05	0.067
Mali	0.09	0.000	0.10	0.034
Mauritania	0.03	0.343	0.02	0.295
Niger	0.04	0.024	0.03	0.228
Nigeria	0.06	0.000	-0.01	0.692
Senegal	0.07	0.000	0.11	0.017
Sierra Leone	0.02	0.604	-0.03	0.405
Togo	0.04	0.025	0.03	0.209
Africa central & south				
Angola	0.03	0.043	0.05	0.031
Cameroon	0.03	0.114	0.02	0.491
Chad	0.03	0.252	0.00	0.981
Congo	0.03	0.134	0.05	0.267
DRC	0.03	0.014	0.02	0.367
Gabon	0.02	0.286	0.00	0.998
Lesotho	0.11	0.019	0.12	0.031
Namibia	0.07	0.009	0.00	0.955
Sao Tome and Principe	0.00	0.991	0.02	0.422
South Africa	0.14	0.086	0.13	0.072
Swaziland	0.09	0.072	0.04	0.471
Africa North				
Morocco	0.06	0.019	0.09	0.003
Americas central				
Dominican Republic	0.02	0.379	0.01	0.640
Guatemala	0.00	0.860	0.03	0.076
Haiti	0.02	0.367	0.05	0.219
Honduras	0.00	0.799	0.01	0.386
Nicaragua	0.03	0.122	0.00	0.853
Americas south				
Bolivia	0.00	0.846	0.04	0.107
Colombia	0.04	0.332	0.03	0.499
Guyana	-0.01	0.484	-0.05	0.139
Peru	0.03	0.070	0.02	0.308
Asia south southeast				
Cambodia	0.09	0.006	0.07	0.086

India	0.07	0.000	0.06	0.000
Indonesia	0.05	0.032	0.06	0.001
Maldives	0.07	0.054	0.12	0.014
Myanmar	0.01	0.803	0.05	0.024
Nepal	0.01	0.791	0.05	0.251
Philippines	0.05	0.013	0.01	0.287
Timor-Leste	0.00	0.956	-0.01	0.749
Asia central west				
Armenia [a]				
Azerbaijan	0.14	0.076	0.16	0.207
Kyrgyzstan [a]				
Tajikistan [a]				
Turkey	0.00	0.967	0.04	0.035

Notes: (a) Dropped from country-level analysis due to a low number of unintended pregnancies reported, but included in the region-level analysis.

Appendix Table 4 Coefficients of FE regressions including only births taking place at least 12 months before the survey, and controlling for mom's age, birth order, and child's sex. Reference category for birth intentions: wanted births.

Birth intentions	Mistimed	p-value	Unwanted	p-value
Africa East				
Burundi	0.08	0.000	0.05	0.117
Comoros	0.07	0.089	0.12	0.196
Ethiopia	0.05	0.139	0.11	0.053
Kenya	0.05	0.004	0.12	0.000
Madagascar	0.02	0.192	0.06	0.031
Malawi	0.08	0.000	0.11	0.000
Mozambique	0.06	0.109	-0.04	0.258
Rwanda	0.11	0.000	0.10	0.000
Tanzania	0.04	0.008	0.06	0.089
Uganda	0.05	0.000	0.11	0.000
Zambia	0.06	0.001	0.02	0.793
Zimbabwe	0.15	0.000	0.17	0.000
Africa West				
Benin	0.05	0.000	0.02	0.664
Burkina Faso	0.08	0.002	0.11	0.138
Gambia	0.03	0.069	-0.02	0.434
Ghana	0.02	0.470	-0.02	0.711
Guinea	0.08	0.008	0.10	0.191
Ivory Coast	0.06	0.034	0.11	0.001
Liberia	0.08	0.089	0.02	0.432
Mali	0.10	0.000	0.12	0.103
Mauritania	0.04	0.162	0.02	0.436
Niger	0.05	0.019	0.08	0.188
Nigeria	0.07	0.000	-0.01	0.854
Senegal	0.11	0.000	0.05	0.002
Sierra Leone	0.06	0.104	-0.04	0.330
Togo	0.05	0.083	0.04	0.498
Africa central & south				
Angola	0.05	0.017	0.08	0.011
Cameroon	0.06	0.008	-0.09	0.273
Chad	0.07	0.043	-0.01	0.879
Congo	0.05	0.015	0.06	0.327
DRC	0.06	0.001	0.04	0.305
Gabon	0.04	0.113	0.01	0.710
Lesotho	0.14	0.004	0.20	0.003
Namibia	0.03	0.256	-0.04	0.467
Sao Tome and Principe	0.05	0.218	0.02	0.366
South Africa	0.07	0.342	0.15	0.042
Swaziland	0.10	0.082	0.15	0.014
Africa North				
Morocco	0.09	0.000	0.12	0.000
Americas central				
Dominican Republic	0.03	0.076	0.03	0.066
Guatemala	0.02	0.193	0.05	0.028
Haiti	0.03	0.228	0.10	0.024
Honduras	0.01	0.421	0.06	0.005
Nicaragua	0.02	0.365	0.01	0.631
Americas south				
Bolivia	0.00	0.963	0.05	0.084
Colombia	0.02	0.440	0.04	0.217
Guyana	0.06	0.127	0.01	0.751
Peru	0.01	0.376	0.04	0.015
Asia south southeast				
Cambodia	0.09	0.001	0.03	0.447

India	0.08	0.000	0.06	0.000
Indonesia	0.12	0.000	0.10	0.000
Maldives	0.02	0.523	0.07	0.124
Myanmar	0.03	0.431	0.06	0.006
Nepal	0.07	0.021	0.13	0.007
Philippines	0.04	0.040	0.03	0.070
Timor-Leste	0.01	0.507	-0.03	0.238
Asia central west				
Armenia [a]				
Azerbaijan	0.00	0.937	0.08	0.465
Kyrgyzstan [a]				
Tajikistan [a]				
Turkey	0.03	0.053	0.03	0.124

Notes: (a) Dropped from country-level analysis due to a low number of unintended pregnancies reported, but included in the region-level analysis.