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Evidence from twin infanticide in Africa

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TRADITION AND MORTALITY: EVIDENCE FROM TWIN INFANTICIDE IN AFRICA

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ABSTRACT. Mortality of twins relative to singletons is no greater today among African ethnicities that once practiced twin infanticide. We introduce data on historic twin infanticide and merge it with birth records from 23 African countries. We use the full sample, a border sample of adjacent societies with and without past twin infanticide, and a sample of twins. All three samples provide no evidence that past twin infanticide predicts greater differential twin mortality today. Twin infanticide and negative attitudes towards twins were suppressed by Africans, missionaries, and colonial governments. Where these channels were weak, we find evidence of greater twin mortality today.

1. INTRODUCTION

In this paper, we show that twin mortality is no higher in the present among ethnic groups in sub-Saharan Africa that practiced twin infanticide in the past. In sub-Saharan Africa, one in five twins die by the age of five (Monden and Smits, 2017). Twins are three times as likely to die as children as singletons, and twins are a rising share of child deaths in Africa (Christensen and Bjerregaard-Andersen, 2017). This mortality differential is concentrated in the first year of life, and in particular in the first month (Pongou, Shapiro and Tenikue, 2019). Despite the widespread prevalence of twin infanticide in the past in sub-Saharan Africa – roughly one quarter of all births in our data on 23 African countries come from ethnic groups that historically practiced the killing of twins – our results rule out both direct and indirect legacies of this practice as explanations of this mortality gap. Recent work in economics has emphasized that, while customs can change dramatically and rapidly (Giuliano and Nunn, 2017), abandoned customs may still affect individuals' attitudes and behavior (Fernández, 2011; Nunn, 2012). That the direct and indirect effects of twin infanticide have become inconsequential provides an

example of cultural change and rapid evolution of social norms through institutions and socialization (Bisin and Verdier, 2011; Young, 2015).

In this paper, we construct novel data on the former practice of twin infanticide among more than 270 ethnic groups in sub-Saharan Africa, at any point in their history. We code this using a wide set of ethnographic sources, covering more than 300 books and articles. We assemble data on more than 1 million children born in 23 African countries between 1958 and 2018, including more than 33,000 twins, from the Demographic and Health Surveys (DHS). Merging these sources, we test in three samples for a link between infant and child mortality of twins in the present and a past tradition of twin infanticide. First, in the *full sample*, we test for greater mortality of twins relative to non-twins among formerly twin-killing groups, conditioning on controls, including (in alternative specifications) country, sub-national region, and mother fixed effects. Second, in a *border sample*, we compare individuals living within 100km of a border separating groups that previously practiced twin infanticide and those that did not. This follows work by Moscona, Nunn and Robinson (2020) and Lowes (2020), and focuses comparisons on groups in close proximity with similar observable characteristics that differ in their historical treatment of twins. Finally, in a *twins sample*, we can implement the above two approaches on the sub-sample of twins, using absolute mortality as an outcome of interest, rather than the mortality of twins relative to singletons. Across all three specifications, we find no evidence of greater mortality among twins in the present among groups with a past tradition of twin infanticide. We also find no evidence of differential early-life investments in twins' health such as vaccination and the duration of breastfeeding among groups with a past tradition of twin infanticide.

In order to understand the historical processes by which former traditions of twin infanticide have become quantitatively unimportant in the present, we begin by considering the possible mechanisms that could link them to present-day mortality. We divide these into direct and indirect channels. By "direct," we mean the possible continued practice of twin infanticide. While journalistic sources still mention isolated instances today, continued infanticide is unlikely to be common: it is illegal. We focus instead on "indirect" channels – possible negative attitudes towards twins that might lead to lower investments in twin health. These have been documented by anthropologists and journalists within living memory. Indeed, among births from the 1970s and earlier in older DHS surveys, we do find evidence of greater differential twin mortality among formerly twin-killing groups.

Next, we turn to the historical record to understand how twin infanticide and negative attitudes towards twins were suppressed. This was a process that drew on the initiative of Africans, of missionaries, and of colonial governments. Together, their efforts

took three of the key channels for historical persistence (multiple equilibria, culture, and domestic institutions (Nunn, 2009)) and either rendered them inoperative or transformed them into mechanisms of non-persistence. We use heterogeneity analyses to show that where these historical processes were weak or absent – far from Protestant missions, distant from colonial cities, in former French colonies, and among mobile, non-agricultural societies – we do still find evidence of a mortality penalty for twins relative to non-twins that is greater in formerly twin-killing societies. We find no evidence that the presence or absence of a differential mortality penalty for twins by past tradition varies across broad regions of Africa, by access to a health facility, by pre-colonial institutions, by ethnic diversity, by migration, by conflict exposure, or by sex composition of the twin pair. Nor does it emerge only in periods of adverse rainfall.

Our null result in the full sample is robust to several alternative empirical approaches, including the inclusion of regression discontinuity polynomials in the border sample, recoding ethnic groups for which the evidence on twin infanticide is poor or contradictory, adding additional maternal, geographic, and ethnographic controls, restricting observations to the rural sample, and considering the possible misreporting of twin births.

1.1. **Contribution.** We contribute primarily to three literatures in economics. The first considers historical persistence. Over the past two decades, several studies have shown how history matters for a wide set of outcomes in the present. These include conflict (Moscona, Nunn and Robinson, 2020), culture (Giuliano and Nunn, 2017; Michalopoulos, 2012); beliefs (Lowes et al., 2017; Nunn and Wantchekon, 2011), gender roles (Alesina, Giuliano and Nunn, 2013; Ashraf et al., 2020), institutions (Giuliano and Nunn, 2013), economic development (Alesina, Michalopoulos and Papaioannou, 2016; Alsan, 2015; Michalopoulos and Papaioannou, 2014; Nunn, 2008; Nunn and Puga, 2012), and individual well-being (Michalopoulos, Putterman and Weil, 2019). Less is known about the effects of cultural norms on health outcomes, including mortality. We provide evidence of non-persistence of one particular historical tradition, and outline the processes by which it became inoperative over time.

The second literature to which we contribute examines child survival rates in low-income countries. Economic and political variables shape child survival (Baird, Friedman and Schady, 2011; Dehejia and Lleras-Muney, 2004; Kudamatsu, 2012; Miller and Urdinola, 2010), including the survival of twins (Pongou, 2013; Pongou, Kuate Defo and Tsala Dimbuene, 2017). We provide evidence on the impact (in this case its absence) of cultural norms, about which less is known (see Arthi and Fenske (2018) for an exception). The causes of twin mortality relative to that of singletons have also received less attention from economists, and we contribute to this literature by ruling out one possible explanation.

The third literature to which our work is related studies the allocation of scarce resources among children. There is evidence both of a trade-off between family size and child quality (Hanushek, 1992; Rosenzweig and Zhang, 2009; Rosenzweig and Wolpin, 1980), and that investments made by parents reinforce initial endowments (Almond and Mazumder, 2013; Almond, Currie and Duque, 2018), though the selective survival of twins to birth complicates inference in this literature (Bhalotra and Clarke, 2018). Several contributions have also examined the degree to which additional births affect outcomes of older siblings (Angrist, Lavy and Schlosser, 2010; Black, Devereux and Salvanes, 2005; Qian, 2009). We test for differential investment in twins, which would be consistent with the implications of the quality-quantity trade-off. We show no evidence that this differential varies by prior traditions of twin infanticide.

We also contribute more narrowly to the set of studies on twin infanticide itself, including Granzberg (1973), Lester (1986), and Ball and Hill (1996). This literature has generally considered pairwise correlations between the practice of twin infanticide and other cultural characteristics in samples coded using the Human Relations Area Files. We add to this literature by coding a larger sample of ethnic groups than any previous study of which we are aware, using multivariate statistical analyses, and considering possible consequences of twin infanticide.

The remainder of this paper proceeds as follows. In Section 2, we explain our three empirical strategies and outline our sources of data. In Section 3, we present our results on mortality and child investments, and describe our principal robustness checks. In Section 4, we discuss "mechanisms." We consider the possible links between past tradition and contemporary mortality that have been shut down, outline the historical processes by which this occurred, and use heterogeneity analyses to show that, where these processes were weak, mortality remains high among twins relative to non-twins in formerly twin-killing societies. We also rule out alternative explanations of our results and briefly discuss additional results and robustness checks that are contained in the appendix. Section 5 concludes.

2. EMPIRICAL STRATEGIES AND DATA

2.1. **Empirical Strategies.** Our data will consist of more than one million children born between 1958 and 2018 from 23 African countries and more than 700 ethnic groups. We will use three broad empirical strategies. The first will use the full sample of observations:

$$Mortality_{iemt} = \alpha + \beta_1 Twin_{iemt} + \beta_2 TwinKilling_e + \beta_3 Twin_{iemt} \times TwinKilling_e$$

(1) $$+ x'_{iemt}\gamma + \delta_x + \epsilon_{iemt}$$

Here, $Mortality_{iemt}$ is an indicator for whether child i from ethnic group e born to mother m in year t died. We use infant mortality (death within the first 12 months of life) and child mortality (death within the first 60 months) as outcomes. $Twin_{iemt}$ is an indicator for whether the child is a twin. $TwinKilling_e$ is an indicator for whether the child's ethnic group has a tradition of twin infanticide. We code this (alternatively) by self-reported ethnicity, or by location relative to the ethnicity polygons in the Murdock (1959) map of Africa. That is: in this alternative coding, we code $TwinKilling_e$ based on whether the ethnic territory in which an individual lives is that of a group that once practiced twin infanticide, regardless of her self-reported ethnicity. β_3, the coefficient on the interaction of $Twin_{iemt} \times TwinKilling_e$, is the coefficient of interest. It assesses the degree to which twin mortality is differentially greater among ethnic groups that practiced twin infanticide in the past. x_{iemt} is a vector of controls. In the baseline, it includes female, birth order, and year of birth. In robustness checks, we add maternal, geographic, ethnographic, and other controls. δ_x is, in alternative specifications, fixed effects for country, region, or for mother. Regions are defined as in the survey data, and are generally second-level sub-national administrative units. In all three cases, these absorb survey year fixed effects. We cluster standard errors by ethnic group. Because there are two ways in which we code $TwinKilling_e$ – by self-reported ethnicity or location in Murdock (1959) – we will change the clustering variable across specifications to match the measure of ethnicity by which $TwinKilling_e$ is coded.

In our second empirical strategy, we restrict our sample to children within 100 km of a border in Murdock (1959) that separates a group with a tradition of twin infanticide from one without this tradition.[1] Our goal here is to limit the possibility of omitted variables bias by comparing members of ethnic groups in close proximity; because these groups will be similar in their observed characteristics, they are also more likely to be similar in their unobserved characteristics. Similar approaches have been used by Moscona, Nunn and Robinson (2020), in assessing the impact of segmentary lineage organization on conflict in modern Africa, and by Lowes (2020) to evaluate the impact of matriliny on spousal cooperation. We will begin by estimating Equation (1) in this border sample. For robustness, we will be able to extend this specification to include regression discontinuity polynomials of the form $f(location_{iemt}, Twin_{iemt})$. For example, we will be able

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[1]The 100 km bandwidth follows Lowes (2020), though we will show robustness to alternative distance cutoffs.

to include distance from the boundary, its interaction with $Twin_{iemt}$, and its interaction with $Twin_{iemt} \times TwinKilling_e$.

In our third empirical strategy, we will focus solely on the sample of more than 33,000 twins. In this case, we will estimate:

$$(2) \qquad Mortality_{iemt} = \alpha + \beta TwinKilling_e + x'_{iemt}\gamma + \delta_x + \epsilon_{iemt}$$

All variables in Equation (2) are defined as in Equation (1). However, now our focus has changed. The parameter of interest is now β – the absolute, rather than relative, mortality of twins in ethnic groups with a tradition of twin infanticide. We estimate Equation (2) in both the full and border samples, with and without fixed effects (δ_x) for country and region. We cannot include mother fixed effects in this specification because they would be collinear with $TwinKilling_e$.

The DHS data we will use are randomly displaced up to 5 kilometres in rural areas and up to 2 kilometres in urban areas. Displacement is done to ensure respondent anonymity, but may create measurement error in $TwinKilling_e$ when we code respondents by their location relative to polygons in Murdock (1959). However, since this will only occur in specifications where a household is assigned to the wrong side of a border that separates an ethnic group with a tradition of twin infanticide from a group without the same tradition, we expect this will only create attenuation bias for a small fraction of observations in the border subsample.

2.2. **Data.**

2.2.1. *Infant and Child Mortality.* Our data on infant and child mortality are taken from the Demographic and Health Survey (DHS) datasets. These are nationally representative surveys of women aged 15-49, and have been conducted in more than 90 countries since 1984. We limit our sample to countries in sub-Saharan Africa for which there is information on both respondent locations (i.e. latitude and longitude) and ethnicity, since these variables will be essential for us to code the presence of a tradition of twin infanticide. In this sample of 23 countries, we use the most recent data set that was available when we began this project in 2019.

In particular, we use data from the Births Recode modules. These ask women about all births they have ever had, including the sex of the child, birth order, year of birth, whether the child was a twin, and, if the child has died, how long the child lived. Across surveys, these give us information on more than one million children born between 1958 and 2018. Of these, 7.5% died in the first 12 months of life, while 12.3% died in the first 60 months of life. We take these as indicators of infant and child mortality, respectively.

FIGURE 1. Excess Twin Mortality by DHS Cluster

Our focus is not on infant and child mortality *per se*, but rather on the excess mortality of twins relative to non-twins. We show two maps of this excess mortality, in Figures 1 and 2. The first map depicts survey clusters – units that roughly approximate villages. We compute, for every cluster, the child mortality rates of twins and of non-twins. We take the difference as a measure of excess child mortality. The second map performs the same exercise, but using the ethnic polygons in Murdock (1959). There is not a clear geographic pattern in either figure, though some regional pockets of high relative twin mortality stand out in the eastern Central African Republic, southern Chad, Niger, and non-highland Ethiopia.

2.3. **Twin Infanticide.**

2.3.1. *Twin Infanticide: the Ethnographic Literature.* Twin infanticide is the act of disposing of either one or both infants from a twin pair, and has been practiced in the past by several societies around the globe (Granzberg, 1973). While not unique to Africa (e.g. Sarkar (2012)), its prevalence there has received considerable attention (Peek, 2011; Renne and Bastian, 2001). Methods of infanticide differed across African societies, but included smothering, drowning, exposure, strangulation, and live burial (Scrimshaw, 1984). In some societies, only one twin was killed. The twin killed might be the weaker one, as among the Khoikhoi of South Africa (Lagercrantz, 1941, p. 169), or selected by gender, as among the Chaga of Tanzania (Carey, 1925, p. 22). In other cases, as with

FIGURE 2. Excess Twin Mortality by Murdock (1959) Ethnicity

Note: Unshaded polygons are ethnic groups not in our sample.

the Itsekiri of Nigeria (Granville and Roth, 1899, p. 106), both twins were killed. In some examples, such as the Efik of Nigeria, the mother would also be killed (Imbua, 2013, p. 142). Anthropologists have paid particular attention to twin infanticide in Africa, since its prevalence was made clear by the earliest ethnographic research on the continent (Ball and Hill, 1996).

Accounts of twin infanticide are often divided into emic and etic explanations – those originating from within the society that practices it and those originating from the researcher. Emic explanations of twin infanticide differ considerably across African societies, and include fears that twins are abnormal, that they can kill the sick, that they arise from adultery, or that they are cursed or evil (Granzberg, 1973, p. 406). Emic explanations may, however, be constructed retrospectively; Leis (1965, p. 102) provides the example of an explanation adopted by Christian converts among Nigeria's Ijaw (that twin infanticide was established in response to a pair of twins who had become destructive, cruel giants) that was unknown by older members of the community. Etic explanations are more likely to appeal to logic familiar to economists. Granzberg (1973) proposes a "materialistic" explanation, that twin infanticide exists where resources are not sufficient for a mother to raise two children at once while meeting other responsibilities, based on the help available to mothers and the degree to which mothers are free from work. Related explanations stress infanticide, including twin infanticide, as the result of

a tradeoff between investments in the survival of different children (Hrdy, 1992) or as a means of reducing population stress on local resources (Milner, 2000).

Other etic perspectives complicate this materialist view. Lester (1986) notes that twin infanticide tends to coexist with male dominance in societies where women have a relatively inferior status. Ball and Hill (1996) show that, while twin infanticide tends to coexist with the killing of other low-viability infants, it does not tend to exist in the same societies that use infanticide as a form of population control or the killing of infants conceived under what a society deems inappropriate circumstances. Marroquín and Haight (2017) argue for an identity economics interpretation; twin infanticide was a costly practice that preserved inclusion in the community. Other discussions have aimed to understand infanticide, including twin infanticide, within the broader social and cultural context (Carolus and Ringen, 2018; Devlieger, 2013; Laughlin, 1994; Minturn and Stashak, 1982; Pector, 2002; Piontelli, 2008; Stewart, 2000).

2.3.2. *Twin Infanticide: Coding.* Although some past studies have made lists of ethnic groups that have practiced twin infanticide, we are not aware of any source with a sufficiently large sample for multivariate analyses, nor for implementation of our border sample design. Thus, we use ethnographic sources to code the presence or absence of twin infanticide for the ethnic groups in our data. We do this two ways – first, for ethnic groups recorded in the DHS data and, second, for the ethnic groups in the polygons of the Murdock (1959) map that intersect the countries in our data. We code these variables as 1 if the literature records that a group practiced twin infanticide at any point in its history.

Coding groups as 0 requires more care. We do not wish to assume that absence of evidence is evidence of absence. Yet, unless twin infanticide is of particular interest to an ethnographer, its absence is unlikely to be reported directly. So, we code twin infanticide as 0 if any of the following conditions is met:

(1) The literature records that it did not practice twin killing.
(2) The literature records that it has a positive or neutral attitude to twins.
(3) The literature records that it has a negative attitude to twins but no direct evidence shows that it killed twins.
(4) There exists literature on the group's tradition of infanticide but twins are not mentioned as one of the situations.

We code a small number of groups as 0 for other reasons, for example if special names are given to twins and we have not identified any other discussion of the role of twins in that society.

We begin by using existing sources that have compiled information on the treatment of twins in multiple societies. The sources of this type from which we will be able to

code twin infanticide for the largest number of ethnic groups are Hartland (1921), Carey (1925), Lagercrantz (1941), Granzberg (1973), Pison (1987), Ball and Hill (1996), and Peek (2011). However, many of the ethnic groups recorded in either the DHS data or in Murdock (1959) are not covered by these sources. As a result, we turn to more than 300 additional books and articles.

We now provide examples for each of the codings in our data. As a group coded 1, the Igbo of Nigeria are perhaps one of the most well-known cases of twin infanticide in Africa, in part due to descriptions in Achebe (1958):

> The children are thrust into an old waterpot without even a passing thought for the pain inflicted. Cocoanut fibre or leaves are thrown in to cover them, and the pot is then deposited in some lonely spot in the bush. The newly born infants receive no attention whatsoever. They are cast away at once, as unclean in the sight of gods and men. ... This method of dealing with twins is reckoned to be the only one open to the parents, as by acting thus they hope to avert further calamity. To permit the children to live would amount to a direct challenge to the malignant spirits, and the parents, and indeed the whole community, would be exposed to all manner of dangers (Basden, 1921, p. 57-58).

For an example of a group that is coded 0 because *the literature records that it did not practice twin killing*, consider the Masai of Kenya. Table 2 on p. 861 of Ball and Hill (1996) lists 38 ethnic groups from around the world and whether they practiced infanticide in the cases of twins, poor quality infants, too many infants, or inappropriate conception. The Masai are coded 0 for both twins and "too many" in this table, and 1 for poor quality and inappropriate conception.

For an example of a group that is coded 0 because *the literature records that it has a positive or neutral attitude to twins*, consider the Fon of Benin:

> The notion of twin beings ... expresses the equilibrium maintained between opposites, which is the very nature of the world. The ideal birth is a twin birth (Mercier (1963, p. 219), quoted in Peek (2011, p. 9)).

For an example of a group that is coded 0 because *the literature records that it has a negative attitude to twins but no direct evidence shows that it killed twins*, consider the Dakarkari of Nigeria:

> Male twins are not wanted because it is said that, if they live, their father will die, and female twins are not wanted because they are thought to cause the death of their mother. Mixed (male and female) twins are regarded favourably, as it is thought that the male counterbalances the female, and vice versa.

> The killing of unwanted twins does not ever appear to have been the custom, but, to this day, a certain ceremony must be observed two years after the birth of male or female twins in order to avert calamity to the father or mother, as the case may be (Harris, 1938, p. 134).

For an example of a group that is coded 0 because *there exists literature on the group's tradition of infanticide but twins are not mentioned as one of the situations*, consider the Bariba of Nigeria:

> These signs are indicative of unusual features of either the infant or the birth process and include: 1) breech birth; 2) birth occurring at eight months; 3) babies who slide on their stomachs at birth; 4) babies born with teeth; and 5) babies whose teeth appear first in the upper gums. Babies displaying these signs either at birth or during teething were customarily killed or abandoned (Sargent, 1988, p. 80).

For an example of a group we have coded 0 for other reasons, consider the Teke–Mbede of Gabon. Green (2017, p. 244) reports the presence of rituals surrounding twin births without providing additional information: "Historically, when twins were born in Teke society a basket was placed next to their heads, in which visitors placed small gifts." This case shows attention to the role of twins among the Teke–Mbede but does not mention infanticide. That Knight (2003) and Dupré (1974) also discuss twins among the Teke–Mbede without mentioning infanticide reinforces our interpretation that, had infanticide been present, it would have appeared in the ethnographic literature.

There are a small number of cases in which conflicting information is available in the available record. The Senufo of the Ivory Coast are one such example. While Knops (1938, p. 484) reports that twins are a blessing,[2] a sentiment reiterated by Lagercrantz (1941, p. 22), Bah and Fanny (2018, p. 101) report the presence of twin infanticide among the Senufo.[3] We show robustness to recoding these groups. In addition, for robustness, we also present results in which we recode all groups for which we lack positive evidence of the presence of twin infanticide as 0.

We are able to code 288 groups, or 81.5% of the sample of births, by self-reported ethnic group and 272 groups, or 74.8% of the sample of births, by location relative to the Murdock (1959) map. This is comparable to similar exercises in the literature: Moscona, Nunn and Robinson (2020), for example, code the presence of segmented lineages for

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[2]"La naissance de jumeaux est considéreé comme une bénédiction, une récompense des fétiches et des esprits ancestraux."

[3]"D'abord, á la naissance, les matrones prennent acte de la situation et en informe le père. Une résolution discrète est prise pour sauver le père. Ainsi, tous les jumeaux, n'ont pas la chance de sortir vivant de l'accouchement. Cette opération est réservée aux matrones. L'ordre lui est donné par les proches d'agir. Ceci est un secret atteste une septuagénaire lors de notre enquête."

FIGURE 3. Twin Infanticide by DHS Cluster

145 ethnic groups covering 38% of the population of sub-Saharan Africa. 28.4% of the sample of births comes from ethnic groups with a history of twin infanticide by self-reported ethnicity, and 24.8% by location relative to the Murdock (1959) map. We provide maps of twin infanticide in Figures 3 and 4. Figure 3 plots the share of births in each DHS survey cluster that is from ethnic groups that practiced twin infanticide. Figure 4 does the same for the Murdock (1959) map, and also shows the boundaries separating twin-killing from non-twin-killing groups, which we will use to define our boundary sample. There is clear geographic clustering in these maps. Twin infanticide is most prevalent in Southern Africa, including Namibia, southern Zambia, and Mozambique, in Western Kenya, and in Southern Nigeria.[4]

2.4. **Other Variables.** We include a number of additional variables in our analyses. First, we take *maternal controls* from the DHS Births Recodes. We record rural/ruban status, as well as mother's age, religion, wealth, and level of education. Wealth is an index included the DHS data and based on a principal components analysis of durable goods ownership.[5] We have harmonized the religions across the various DHS waves into the categories of Animist, Christian, Missing, Muslim, None, and Other.

[4]While we cannot include Botswana, Zimbabwe, South Africa, and Tanzania due to lack of suitable ethnicity or geographic data in the DHS, substantial geographic clusters of twin infanticide also exist in these countries.

[5]While this is in the Births Recodes in most cases, for some rounds we merge this variable in from other sections of the survey.

FIGURE 4. Twin Infanticide by Murdock (1959) Ethnicity

Geographic controls included in the child-level regressions are taken from the DHS GIS file. We record latitude and longitude, precipitation, aridity, a vegetation index, and malaria incidence. We use the 2015 values of these variables for consistency across surveys. We also include an indicator for rural from the Births Recodes. In additional analyses, we will assess the degree to which the presence of twin infanticide correlates with the geographic characteristics of the ethnic polygons reported in Murdock (1959). These include area shares by major vegetation type from White (1983), explorer routes and colonial railroads from The Century Company (1897), caloric suitability from Galor and Özak (2015, 2016), altitude, pasture suitability, forest cover, precipitation, slope, temperature, and suitability for several crops from the Food and Agriculture Organization of the United Nations (FAO) Global Agro-Ecological Zones project, humidity from the Climatic Research Unit at the University of East Anglia, tsetse suitability from Alsan (2015), suitability for nomadic pastoralism from Beck and Sieber (2010), ruggedness from Nunn and Puga (2012), malaria suitability from Kiszewski et al. (2004), population density in various years from both the Gridded Population of the World and Klein Goldewijk et al. (2010), pre-colonial conflicts recorded in Brecke (1999), mines recorded in U.S. Geological Survey, missions recorded in Roome (1925), and ecological diversity from Fenske (2014).[6] We also compute distance from the coast, area, and absolute latitude ourselves.

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[6]Explorer routes, colonial railroads, and missions were digitized first by Nunn (2014).

We also include a number of *ethnographic controls* – other characteristics of the ethnic groups in our data recorded in the Murdock (1967) *Ethnographic Atlas*. We focus on five variables that have featured in other empirical work on path dependence in Africa: Jurisdictional Hierarchy, Patrilineal, Polygynous, Importance of Agriculture, and Female Participation in Agriculture. The Ethnographic Atlas reports information on 1,265 ethnic groups from around the world, 486 from sub-Saharan Africa excluding Madagascar. We merge these to our data based on the name of the ethnicity in the DHS when we code twin infanticide based on self-reported ethnicity, and by the name of the ethnicity in Murdock (1959) when we code it based on location.

Jurisdictional Hierarchy, used previously by both Gennaioli and Rainer (2007) and Michalopoulos and Papaioannou (2013), is based on Variable 33 in the Atlas. It measures state centralization, and records the number of jurisdictional levels above the local community, ranging from none to four. We construct an indicator for whether a society has more than one level of hierarchy above the local. Patrilineal, based on Variable 43 in the Atlas, captures whether descent is through the male line. Matriliny, an alternative to patriliny, is the main focus of Lowes (2020). Polygyny, previously used by Fenske (2015), is based on Variable 8 in the Atlas. This measure codes the mode of domestic organization categorically, and we create a dummy equal to 1 if a society is recorded either as "polygynous: unusual co-wives" or "polygynous: usual co-wives." The Importance of Agriculture, previously used by Michalopoulos, Putterman and Weil (2019), codes the dependence of a society on agriculture for subsistence into ten categorical levels, from 0-5% dependence to 86-100% dependence. We will use a dummy variable equal to 1 if the importance of agriculture is greater than 55%. Female participation in agriculture, previously used by Alesina, Giuliano and Nunn (2013), is based on Variable 54 in the Atlas. We create an indicator equal to 1 if female participation is equal to that of men or greater.

As additional outcomes, we measure *investments in child health*. We take these from the DHS Children's Recode (KR), which asks only about children born within five years of the survey date, and so gives us a smaller sample than in our baseline analysis of mortality. Mothers are asked a series of questions about vaccinations, duration of breastfeeding, the conditions under which children were born, and their current health outcomes.

We report summary statistics in Table 1. For the more than one million children in the sample, we have been able to code the past presence of twin infanticide for more than 825,000 based on DHS ethnicity and more than 750,000 based on location relative to the Murdock (1959) map. A bit more than 3% of births in our sample are twins, consistent with the high twinning rates found in sub-Saharan Africa (Smits and Monden, 2011). While the earliest births in the sample are in the late 1950s, the mean year of

birth is 2002. Approximately 7.5% of births in the sample are children who died in the first year of life, and roughly 12% died in the first five years. Approximately 40% of the sample is within 100km of a border separating an ethnic group that once practiced twin infanticide from one that did not.

3. RESULTS

In this section, we present our estimates of Equation (1) in the full and border samples, and of (2) in the sample of twins. If twins face an additional mortality penalty among former twin-killing groups relative to the twin mortality penalty among other groups, it is both quantitatively small and statistically insignificant. We also present our estimates taking investment in child health as outcomes. We find no evidence that twins receive fewer health investments among former twin-killing groups, nor that their health is differentially worse among these groups.

3.1. **Baseline Mortality Results.** In Table 2, we present our estimates of Equation (1) in the full sample. In the first three columns, we use infant morality as an outcome. In the next three columns, child mortality is the dependent variable. For each outcome, we report results including country fixed effects, region fixed effects, and mother fixed effects. The last of these are collinear with the variable $TwinKilling$. In Panel A, twin infanticide is coded by self-reported ethnicity in the DHS data. Across columns, the coefficient on $Twin \times TwinKilling$ is insignificant. It is also small (0.003-0.009) when compared with mean mortality (0.07-0.12) or the coefficient on $Twin$ (0.17-0.18). In Panel B of Table 2, we code twin infanticide based on the Murdock (1959) map. Across columns, the coefficient on $Twin \times TwinKilling$ is again small and insignificant. It is also negative in several columns. In the full sample, then, we find no evidence of greater twin mortality among former twin-killing groups.

Because it is possible that groups with a former tradition of twin infanticide differ along unobserved dimensions from those without this tradition in ways that could contribute directly to the twin mortality penalty, we present our estimates of Equation (1) in our border sample in Table 3. Groups in close proximity to each other should be more similar in their observed and unobserved characteristics. Here too, we find no evidence of a differential mortality penalty for twins in former twin-killing societies. As in Table 2, we show results for both infant and child mortality, coding twin infanticide by both self-reported and Murdock (1959) ethnicity. We include, alternatively, country, region, and mother fixed effects. Again, across columns and panels, the coefficient on $Twin \times TwinKilling$ is insignificant and quantitatively small when contrasted with the size of the twin mortality penalty, which ranges from 16.3 to 19.6 percentage points across specifications.

Our focus in Tables 2 and 3 has been on the mortality of twins relative to singletons. In Table 4, we focus instead on the absolute mortality of twins and present estimates of Equation (2). We show results for both infant (columns 1 and 2) and child (columns 3 and 4) mortality. Similarly, we code twin infanticide by DHS ethnicity (panels A and C) and location in the Murdock (1959) map (panels B and D) in the full (panels A and B) and border (panels C and D) samples. We show results with country and region fixed effects, but not mother fixed effects, since these are collinear with $TwinKilling$. Across specifications, we find little evidence of greater twin mortality in former twin-killing groups. The lone positive and significant coefficient of 0.019 – in column (4) of Panel A – is significant at the 10% level and is, in magnitude, less than 10% of the average child mortality rate among twins, which is 0.299. Other coefficients in the table are insignificant, sometimes negative, and small relative to the means of the outcome variables.

3.2. **Investments in Children.** Using the DHS Children's Recode, we are able to examine a large number of investments made for children born within the five years preceding the survey. These include vaccination, duration of breastfeeding, and health outcomes. In Table 5, we present estimates of (1) with these taken as outcome variables. We find no evidence of differential investment in twins relative to non-twins in societies with a past history of twin infanticide. Most coefficient estimates are small and insignificant relative the means of the dependent variables. In many cases they are positive, suggesting that, if anything, health investments twins receive relative to non-twins are greater in former twin-killing societies. For space, we only report results coding respondents by self-reported (DHS) ethnicity. Anthropometric measures of health – weight for height, weight for age, height for age, birth weight, and subjectively reported size at birth – tell a similar story. The gap in health outcomes between twins and non-twins is no worse in former twin-killing societies. We show below that results using ethnicity based on the Murdock (1959) map are similar.

3.3. **Robustness.** In the remainder of this section, we discuss a number of robustness checks and other empirical exercises that we present in the appendix. We begin in Table A1 by reporting the correlates of whether we have been able to code the presence or absence of twin infanticide in an ethnic group. Our sample here is the 543 groups in the Murdock (1959) map that intersect the countries in our data. We report the coefficient and standard error from several simple regressions. In each, the dependent variable is whether twin infanticide variable is missing and the independent variable is a single geographic or ethnographic characteristic of the ethnic group. For ease of interpretation, any variable that is not a percentage (e.g. share or percentage woodland) or a dummy (e.g. river) has been normalized to have mean 0 and standard deviation 1.

There are several variables that predict whether a group is missing from the data. Generally, these tell a consistent story: groups in more difficult environments (woodland, forest, greater temperature, presence of malaria), in areas that were harder to access (further from coast, absence of a river), those with less contact with Europeans (fewer slave exports, lack of a colonial railroad, lack of the presence of explorers, fewer missions), and those that are smaller (sparser population, smaller area, smaller total population) are less likely to appear in the data. To bound the possible bias due to the fact that groups are not missing at random from the data, we report robustness to recoding all missing groups as 0.

In Table A2, we report balance tests. That is, we assess whether the presence of twin infanticide correlates with observable characteristics of the ethnic groups in our sample. Mirroring A1, our sample is the 304 groups in the Murdock (1959) map that we have successfully coded.[7] We again report the coefficient and standard error from several simple regressions. Only a handful of variables correlate significantly with twin infanticide. Notably, other important ethnicity-level variables that have appeared in the economics literature – the importance of agriculture, polygyny, the presence of states, patriliny, and female participation in agriculture – do not correlate with twin infanticide.

Among the significant correlations, the presence of a colonial railroad, proximity to the coast, the presence of missions (in particular Protestant missions), and greater total population all predict the presence of twin infanticide. We interpret these as showing a similar pattern: greater contact with European observers increased the probability that twin infanticide was detected while it either continued to exist or had still existed recently enough to be uncovered in oral testimony. We will address the relationship between missions and twin infanticide below. For additional robustness, we will include these significant correlates of twin infanticide as controls below.

In our baseline regressions, we have only included a sparse set of controls. Because our main result is a null effect, we wish to avoid biasing our results towards zero due to a too demanding specification or towards insignificance by including a set of controls collinear with twin infanticide. It is, however, possible that omitted variables that predict twin infanticide correlate negatively with twin mortality, biasing our baseline estimates. To alleviate this concern, in Table A3, we show the results of adding several additional controls to our baseline specification.

In successive columns, we show results controlling for variables from the *Ethnographic Atlas* (importance of agriculture, polygamy, jurisdictional hierarchy, patrilineal, role of women in agriculture), characteristics of mothers (age, age squared, education, rural,

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[7]This number is greater than the 272 groups we have coded by location relative to the Murdock (1959) map since not every polygon in Murdock (1959) contains a survey cluster in the DHS data.

religion) and geography (precipitation, aridity, surface temperature, vegetation index, malaria prevalence). These controls do little to change the results.

In Table A4, we perform a similar exercise. We control for all variables from Table A2 that were significantly different between twin-killing and non twin-killing groups. The results are largely unchanged.

Our baseline border sample estimations did not include regression discontinuity polynomials, as we did not wish to bias them towards zero with a too demanding specification. In Table A5 we add these. First, column (1) controls for a linear polynomial in distance to the border. We allow the slope to change at the border. Second, column (2) implements a procedure similar to that in Dell (2010) by controlling for latitude and longitude. Neither of these have a notable effect on our coefficient estimates. In columns (3) and (4) we report that are results are largely unchanged if we either double or halve the bandwidth used to define our border sample.

There are some groups in the data for which the evidence in the literature is contradictory or of poor quality. In Table A6 in the appendix, we show that this does not drive our results. In particular, for 26 ethnic groups, we show the result of either recoding the group to the opposite coding of $TwinKilling$, or recoding it as missing.

Because the durability of tradition may be stronger in rural societies, and because we measure ethnicity with more error in urban contexts – particularly when using location in the Murdock (1959) map – we show in Table A7 that our results remain similar when estimated on the rural sub-sample of the data.

Finally, because it is possible that we may fail to find a continued mortality penalty among formerly twin-killing groups because they conceal twin births, we show in Table A8 that twinning rates reported in the DHS data are no lower in these societies. In particular, we make whether the birth is a twin a dependent variable. The coefficient on $TwinKilling$ is small in both the full and border samples.[8]

4. MECHANISMS

So far, we have shown that there is no differential mortality penalty in the present for twins among ethnic groups with a former history of twin infanticide. This means that both direct and indirect channels connecting this past tradition to present outcomes have been reduced to quantitative unimportance. In this section, we discuss the likely

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[8]Because many DHS surveys do not count all pregnancies and ask only about whether the respondent has ever had a terminated pregnancy and not whether it was spontaneous or induced (Sánchez-Páez and Ortega, 2019), we are unable to directly examine abortion. While abortion is more common in sub-Saharan Africa than in Europe or North America, it remains widely unsafe and illegal, and is less common than in Asia and North Africa (Bearak et al., 2020; Lauro, 2011).

mechanisms linking past infanticide to present mortality that might have been deactivated in the sample. We then outline the historical processes identified in the literature that led to the end of twin infanticide in Africa. We then show that, where these processes are weak – distant from Protestant missions, from colonial cities, in non-agricultural societies, and in formerly French Africa – the data continue to suggest a continued differential mortality penalty for twins in formerly twin killing societies compared to others. Finally, we show a number of empirical results suggesting that alternative mechanisms are likely to have been unimportant in the suppression of the direct and indirect legacies of twin infanticide.

4.1. **Past mechanisms that have ceased in importance.** One possible mechanism that would have led to a persistent mortality penalty among twins would be a direct one: continued twin infanticide. Both international and African news sources do report that the practice continues in certain villages, for example among the Bassa Komo in Nigeria,[9] or among the Bakusu in Kenya.[10] However, given the legal status of infanticide, we would not expect this direct channel to be of quantitative importance in the present.

Rather, a more plausible channel that would explain a persistent mortality penalty would be the survival of negative attitudes towards twins – attitudes that would shape, even subconsciously, how twins are treated and the investments made in them. This mechanism would be analogous to the role of religious rituals, notions of female safety and purity, and gender norms in explaining differential health investments in children by gender (Bharadwaj and Lakdawala, 2013; Jayachandran, 2015). Bastian (2001, p. 24), for example, recounts views she encountered during her Nigerian fieldwork during the 1980s:

> From this we may gather that multiple births are still considered something of an embarrassment. ... One set of twins who were spoken of with some frequency had spent most of their lives in the United Kingdom, supposedly because they were also albinos. ... It was claimed that if they were to come home to live in Onitsha, the twins would surely die from the heat.

She also encountered, in 1987, a recent mother of twins in a hospital in Enugu (Nigeria) that was being displayed as a curiosity to more well-off visitors (p.24). In 1991, 9% of Efik, Ibibio, and Annang women in Nigeria believed twins had inhuman origins, 2.3% stated they would reject them, and 2.6% stated they would have them killed (Asindi

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[9]https://www.reuters.com/article/us-nigeria-infanticide-twins-idUSKBN1H419S and https://www.theguardian.com/working-in-development/2018/jan/19/twin-baby-dies-secret-killings-nigeria-remote-communities

[10]https://www.bbc.co.uk/news/world-africa-12280109 and https://www.standardmedia.co.ke/entertainment/crazy-monday/2001252098/blessing-or-curse-communities-that-celebrate-or-kill-twins

et al., 1993). Some Haya in Tanzania believe today that twins can inflict vitiligo on those who upset them (Lutatinisibwa, 2017).

Other recent anthropological work has identified the recent existence of beliefs that twins are unusual and potentially dangerous. Diduk (2001, p. 33) reports a woman from a wealthy family in Cameroon who, in 1990, reported that she was not told her sister had died while studying medicine in Germany until the sister was buried in Cameroon. She had not been told in order to prevent the living twin from being drawn back to the "die world." In 1998, the cost of rituals for twins in Kedjom society (Cameroon) was more than 1,000 USD (ibid., p. 39). In Niger, Masquelier (2001, p. 47,51) reported that twins were still associated with witches and spirits and believed to possess exceptional powers. During the 1990s, adherents to the recently formed Izala faction of Islam were spreading the view that twins were due to maternal adultery (ibid., p. 56). Renne (2001, p. 67) reports the testimony of one older Yoruba woman in Nigeria that parents were reluctant to take twins to Western hospitals, preferring shrines instead. Similar evidence of present-day attitudes comes from journalistic sources, such as in the Ivory Coast.[11]

Since the existence of these types of attitudes has been attested to by anthropologists and journalists within living memory, we use Table 6 to assess whether there is any evidence of a differential twin mortality penalty among former twin-killing groups in the earliest births in our data – those from 1980 and earlier.[12] In order to increase the number of births in the data from these years, we add all earlier DHS waves that contain ethnicity data, bringing the total number of datasets used in this Table to 49. Because these earlier waves lack latitude and longitude coordinates, we are only able to re-estimate equation (1) in the full sample, with $TwinKilling$ coded by self-reported ethnicity. The positive and significant coefficient on $Twin \times TwinKilling$ in this sample is evidence of differential mortality of twins among former twin-killing groups for births dating from before 1980. Similarly, in the sample of twins, there is evidence of higher absolute twin mortality in formerly twin-killing groups, though this is no longer significant after the inclusion of dataset-by-region fixed effects. In the full sample, the additional mortality penalty for twins is close to 6 percentage points, roughly 20% of the typical twin mortality penalty given by the coefficient on the indicator for twin.

4.2. How Twin Infanticide was Suppressed.

How, then, were both twin infanticide and negative attitudes towards twins suppressed in Africa? Our reading of the secondary

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[11]https://www.arabnews.com/node/1402781/offbeat   and   https://www.npr.org/sections/goatsandsoda/2017/11/25/563341944/photos-people-think-the-twins-of-abidjan-can-make-a-wish-come-true?t=1597086104888

[12]We select 1980 as it predates the ethnographic evidence we describe but preserves sample size, given the scarcity of data from earlier birth years. Results are similar using other cutoff dates between 1975 and 1985.

historical literature is that this was due to the initiative of Africans, of missionaries, and of colonial administrators. Nunn (2009) has identified multiple equilibria, culture, and domestic institutions as three of the principal mechanisms that lead to historical persistence. Together, actions of Africans, missionaries, and administrators acted on these three channels, preventing them from leading to persistence.

First, it was the actions of Africans that led to the end of twin infanticide. By 1900, the Zulu had largely adopted colonial and Christian notions towards child killing (Badassy, 2011, p. 21). Similarly, many of the Yoruba-speaking peoples of Nigeria had reversed the tradition of twin infanticide prior to colonial rule (Renne, 2001, p. 64). One tradition holds that this was due to a decision of Ajaka, the Alafin of Oyo (ibid.). An alternative version stresses cultural diffusion, after a Yoruba woman gave birth in Isokun (Benin), where twin infanticide was not practiced (Chappel, 1974, p. 252). In Calabar (Nigeria), African rulers such King Eyo Honesty II began to offer refuge to twins and their mothers during the 1850s (Imbua, 2013). African mothers in Zimbabwe actively resisted pressure from others in their communities, even before colonial rule, and sought help from missionaries in protecting their children (Zimudzi, 2004, p. 514, 516). Bastian (2001, p. 18) gives similar examples from Onitsha (Nigera). In Okitipupa (Nigeria), the reforming chief Nigwo of Igbotako confronted the Ijamo Society of chiefs on several occasions to oppose twin infanticide until the British banned the society for its continued support of the practice (Richards, 1983, p. 11).

African Christians were particularly important in changing norms around twins. Pratten (2007, p. 67) gives the example of a woman within the small Christian community at Ibeno (Nigeria) who had been banished from her town for giving birth to twins and later enslaved before marrying a local chief. When he 'put away' eleven of his wives on converting to Christianity, she married one of the preachers at the Qua Iboe Mission, evidencing her integration into this new community. In Natal (South Africa), Christian converts had rejected infanticide before the twentieth century (Badassy, 2011, p. 21). Among the Annang (Nigeria), mothers of twins were among the outcast groups, also including slaves and strangers, that were disproportionately represented among converts (Pratten, 2007, p. 67). When twin infanticide was prohibited in the Annang region in 1899, it was a Christian convert, Etia, who nursed twins until they would be accepted by their mothers (Pratten, 2007, p. 68).

Other African attitudes towards twins have also changed due to African initiative. Among the Kedjom of Cameroon, the practice of giving a twin child to the chief began to be replaced in the 1940s by gifts of money as the cash economy and practice of wage labor both spread (Diduk, 1993). Christian belief and western education have, similarly, undermined twin rituals in Yoruba regions of Nigeria (Renne, 2001, p. 72).

Second, missionaries were important agents of cultural change. Individual missionaries such as Mary Elms, Hope Waddell and Mary Slessor campaigned against the practice (Proctor, 2000). In southeastern Nigeria, twin infanticide was one of the main causes taken up by missions, and the practice had largely ended by the 1930s (Bastian, 2001, p. 13). In Onitsha (Nigeria), European and African missionaries of all denominations worked against the practice. (ibid., p. 14). The Catholic Holy Ghost Fathers built a Christian village that would accept twins (p. 18), while the Church Missionary Society established a twin house that local elders agreed to help fund (p. 19). Renne (2001, p. 65-66) gives a similar timing of events in the areas of Yorubaland (Nigeria) outside Oyo control; north of Kabba, twin infanticide continued into the 1920s, while in Okitipupa Division African Christians accused the local Native Authorities of continuing to support the practice in the 1940s. At Egbe (Nigeria), the Christian mission took on unwanted babies, including twins (ibid.).

Wangila (2007, p. 111) names the spread of Christianity as one reason for the abandonment of twin killing in Kenya. The Girls' Institute operated by the Qua Iboe Mission in Nigeria became a refuge for mothers of twins (Pratten, 2007, p. 162). In Southern Rhodesia (Zimbabwe), James Hay Upcher would visit kraals in which twins had been born and warned parents that they could be prosecuted if twins were harmed (Zimudzi, 2004, p. 514). The missionary impact on African attitudes towards twins was broader than condemnation of infanticide. In northern Cameroon, Catholic and Swiss Presbyterian churches preached against rituals related to twins (Diduk, 1993).

Third, colonial administrators took actions that helped bring about the end of twin infanticide and changed attitudes. Clauses against twin infanticide were included in treaties between the British and local Nigerian rulers as early as the 1850s (Pratten, 2007, p. 74). As with other forms of infanticide, colonial courts treated twin infanticide as homicide (Devlieger, 2013). It was prosecuted by colonial governments, and the leniency they showed fell over time (Badassy, 2011; Harris, 1922). In Southern Rhodesia (Zimbabwe), offenders were sentenced to death but then shown mercy and not executed (Zimudzi, 2004, p. 512). Pratten (2007, p. 159) gives similar examples from Nigeria. in 1909 in Oron, provisions were made under the Births and Deaths Ordinance that parents of twins were required to register them and present them at court every three months. The Ikot Obong Court took action in 1907 against husbands who deserted their wives for giving birth to twins, and many women were then accepted back into their families. Some officials were even more proactive; the Native Commissioner of Matobo District (Zimbabwe) kept a register of all twins born (Zimudzi, 2004, p. 514).

Those involved knew that they were changing an equilibrium from which deviation could be difficult for any individual African, even if they did not use the language of

economics. The 1907 report on Nigeria's Ikot Ekpene district, after stating that the Minor Court had taken action against husbands of twin-bearing women who had abandoned them, noted:

> In many cases the owners of these women, before the Court took action, had been willing to receive them back but were not prepared to stand the taunts and jibes of their neighbors for so doing. The Native Court having taken the initiative removed all scruples in this respect and the women were taken back.[13]

Missionary efforts were sometimes supported by specific administrators, such as John Beecroft and Claude MacDonald in the case of Mary Slessor in Nigeria (Imbua, 2013). The line between missionary and colonial official could be a blurry one; Slessor was made a vice-consul with authority to preside over a local court (Proctor, 2000). When chiefs at Etinan (Nigeria) asked the Irish missionary Samuel Bill not to interfere with twin infanticide, he replied that he would appeal to the British Consul for assistance, with force if needed, were he to hear about such practices (Pratten, 2007, p. 73). The role of colonial intervention should not, however, be overstated; Leys (1959), for example, mocked the "fatuous ineptitude" of a newspaper in Southern Rhodesia (Zimbabwe) that noted how "natives" had gone from killing twins to being proud of them under white "partnership."

4.3. **Heterogeneity.** We now show a number of heterogeneity analyses, demonstrating how estimates of Equation (1) differ across sub-samples of the data. Across these, a pattern emerges: where the mechanisms by which twin infanticide and negative attitudes towards twins were suppressed have been weaker historically, we do find some evidence of the continued existence of a mortality penalty for twins that is greater among previously twin-killing societies relative to others.

First, splitting the sample by proximity to missions, there is suggestive evidence of greater differential mortality of twins among groups with a former tradition of twin infanticide that are distant from Protestant missions. In particular, in Table 7, we cut the sample by whether a DHS cluster is above or below the median distance to a colonial mission reported in Roome (1925). While this is by no means a complete map of missions in Africa, it captures some of the oldest and most durable missions on the continent and has been used by at least 30 studies of missions (Jedwab, Meier zu Selhausen and Moradi, 2018). Panel A shows that child mortality is 3 or 4 percentage points greater for twins from formerly twin-killing groups in locations distant from colonial missions. In Panel B, this differential is driven entirely by Protestant missions – we do not report

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[13]National Archives of Nigeria, Enugu, Cal. Prof. 14/4/119.

results for distance from Catholic missions as there is no mortality penalty in either the above-median or below-median sub-sample based on distance from a Catholic mission. Using instead the preferred distance cutoff from Nunn (2014), 25 kilometers, there is evidence of a greater mortality penalty distant from Protestant missions, though it is only statistically significant in some specifications.

Why Protestants? The literature has documented a wide-ranging impact of missions on outcomes such as education (Okoye and Pongou, 2014; Wantchekon, Klašnja and Novta, 2015), gender roles (Nunn, 2014), newspaper readership (Cagé and Rueda, 2016), and democracy (Woodberry, 2012). Our results complement this literature. The Catholic-Protestant distinction has several likely sources. Protestant missionaries were more numerous per capita in sub-Saharan Africa (Gallego and Woodberry, 2010). In British colonies, where indirect rule kept traditional authorities in power, missions brought new beliefs, norms, and alternatives to village life that reduced cooperation with these authorities (Okoye, 2017). Conversionary Protestants were particularly active in promoting religious freedom, mass education, printing and the spread of newspapers, civil society, colonial reforms, and legal codes that protected Africans (Woodberry, 2012). Protestant missions also placed greater weight on the education of women (Nunn, 2014). Together, these suggest distance from a Protestant mission will be more salient than distance from a Catholic mission

In Table 8, we similarly show that the differential mortality of twins is greater among former twin-killing groups in areas distant from colonial cities. In particular, we use data on cities and their locations from Africapolis.[14] Taking cities that existed in 1960 as an approximation of cities present in the late colonial period, we show that the interaction of $Twin \times TwinKilling$ is positive and significant in areas more than median distance from a city in these data. The magnitude of this differential, roughly 2.5 percentage points, is greater than 10% of the usual twin mortality penalty. It was from cities such as these that the colonial state projected its authority, and even in the present day the state is often weak distant from major cities (Bubb, 2013; Michalopoulos and Papaioannou, 2014). In Zimbabwe, those convicted of killing twins could not use ignorance of the law as a defence, but remoteness from European centers was considered a mitigating factor and offenders were punished more severely if they had killed twins near European centers (Zimudzi, 2004, p. 513).

In table A10, in the appendix, we provide supporting evidence from the importance of agriculture in precolonial society as measured in the Murdock (1967) *Ethnographic Atlas*. Dividing the sample into those above and below 55% dependence on agriculture, we find greater differential twin mortality among formerly twin-killing societies in the

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[14]https://www.africapolis.org/home

less agricultural sub-sample. As with peoples far from colonial cities, non-agricultural peoples also remained distant from colonial authority due to their exceptional mobility, often resisting taxation and incorporation into the cash economy (Gardner, 2012). This is analogous to parts of the Southeast Asian Massif where several peoples have used swidden agriculture and picking as strategies to evade incorporation into lowland rice producing states (Scott, 2009).

Splitting the sample by colonizer, there is suggestive evidence of greater differential mortality of twins among groups with a former tradition of twin infanticide in former French colonies. We present these results in Table 9, breaking the sample into British colonies, French colonies, and all others – Ethiopia, Liberia, Mozambique, and Namibia. There is some evidence that relative child mortality, though not relative infant mortality, remains higher among twins from formerly twin-killing groups in former French colonies. French colonization differed from British colonization in many ways that would have weakened the forces working to eliminate twin infanticide and its associated beliefs: it provided less mass education (Asiwaju, 1976; Cogneau and Moradi, 2014; Dupraz, 2019), created less state capacity (Cogneau, Dupraz and Mesplé-Somps, 2018), extracted more (Huillery, 2014), and relied more heavily on forced labor (Van Waijenburg et al., 2018). Protestant missions were particularly concentrated in British colonies, where they faced fewer restrictions on their operation (Gallego and Woodberry, 2010).

4.4. **Alternative mechanisms.** In this section, we outline a number of additional results that we report in the appendix, and that help exclude alternative explanations of the lack of a present-day differential mortality penalty for twins in former twin-killing groups. We begin by showing additional heterogeneity analyses, in which we estimate Equation (1) in different sub-samples of the data.

In Table A9, we find no evidence that the results differ by United Nations region – West Africa, Central Africa, East Africa, or South Africa. It would be possible that excess mortality would continue to be high among twins from former twin-killing groups if health facilities were unavailable, making investments in their health particularly costly. We show in Table A11, however, that this is not the case. We measure the availability of a health facility for each DHS cluster by the share of respondents who claim that one is available. Splitting the sample by the median availability of health facilities shows no significant interaction on $Twin \times TwinKilling$ in either sub-sample.

In Table A12, we consider the possibility that pre-colonial institutions may have inhibited the disappearance of twin infanticide and associated negative attitudes towards twins. We consider four institutional and cultural characteristics of societies that have featured prominently in recent work in economics: polygyny, jurisdictional hierarchy, patriliny, and female participation in agriculture. Across samples, we find little evidence

of a differential twin mortality penalty among formerly twin-killing groups. The exception is one specification in the non-polygynous sample. Since this represents less than 2% of the sample and varies by which fixed effects are included, we do not take this as evidence of meaningful heterogeneity.

In Tables A13, A14, and A15, we consider three measures of factors that might have recently disrupted existing social norms – ethnic diversity, migration, and conflict. We begin by computing an ethnic diversity measure for each cluster in the DHS data by computing a Herfindahl index based on the shares of the sample coming from each ethnic group in the survey. Despite substantial intra-group heterogeneity, ethnic identity is a predictor of norms, values and preferences (Desmet, Ortuño-Ortín and Wacziarg, 2017). Splitting the sample by clusters above and below the median according to this fractionalization measure, the coefficient on $Twin \times TwinKilling$ is insignificant in both sub-samples. We measure migration by counting the fraction of respondents in the DHS data who claim that they were born somewhere other than the cluster in which they are currently living. Dividing the sample by the median rate of migration, we show in Table A14 that the coefficient on $Twin \times TwinKilling$ is again insignificant in both samples.

To measure conflict, we consider battle deaths in the Uppsala Conflict Data Program's Georeferenced Event Dataset Global version 20.1 (Pettersson and Öberg, 2020; Sundberg and Melander, 2013). This source reports the number of battle deaths in more than 200,000 conflict events since 1989. For each survey cluster, we count the number of battle deaths occurring within 50km, and divide the sample into clusters that have experienced above-median and below-median conflict intensity. Table A15 shows that the coefficient on $Twin \times TwinKilling$ is insignificant in both sub-samples. Alternative distance cutoffs such as 25 km and 100 km give similar results, but are omitted for space.

As mentioned above, for some cases in our data it is mentioned in the ethnographic record that twin infanticide would be selective by gender. In Table A16, we show that we find no significant differences by the gender of the twin pair. To do this, we estimate:

$$
\begin{aligned}
Mortality_{iemt} =& \alpha + \beta_1 Twin_{iemt} + \beta_2 TwinKilling_e + \beta_3 Twin_{iemt} \times TwinKilling_e \\
& + \beta_4 TwinKilling_e \times BothFemale_{iemt} + \beta_5 TwinKilling_e \times Mixed_{iemt} \\
& + \beta_6 BothFemale_{iemt} + \beta_7 Mixed_{iemt} \\
& + x'_{iemt}\gamma + \delta_x + \epsilon_{iemt}
\end{aligned}
$$
(3)

All but two new variables are defined as in Equation (1). The two new terms are $BothFemale_{iemt}$ and $Mixed_{iemt}$. We code $BothFemale_{iemt}$ equal to 1 for twin pairs that are both female, and 0 for both singletons and other twin pairs. We code $Mixed_{iemt}$ equal to 1 for twin pairs that have a boy and a girl, and 0 for both singletons and other

twin pairs. Because these two variables are 0 for non-twins, the triple interaction terms $Twin_{iemt} \times TwinKilling_e \times BothFemale_{iemt}$ and $Twin_{iemt} \times TwinKilling_e \times Mixed_{iemt}$ do not appear in the regression.

This means that β_1 captures the differential mortality of all-male twin pairs relative to non-twins. β_6 measures whether this is greater if both children are female. β_7 measures whether this is greater if the pair is mixed. β_3 captures whether the mortality of twins relative to non-twins is greater in formerly twin-killing societies. β_4 captures if this additional penalty is any greater for all-girl pairs than for all-boy pairs. β_5 does the same for mixed pairs, relative to all-boy pairs. Across specifications, Table A16 shows no differential mortality penalty for twins in formerly twin-killing societies, nor any significant deviations of the penalties for all-female and mixed pairs from that for all-boy pairs.

It is possible that, while twin infanticide and lingering negative attitudes towards twins no longer matter on average, in periods of distress these could shape investments made in child health and the selective survival of twins relative to non-twins. Similar patterns have been found for gender-biased survival rates in countries with son preference; in India, for example, favorable rainfall has a greater impact on the survival of girls than of boys (Jayachandran, 2015; Rose, 1999).

We test for this in Table A17. We use geocoded data on gridded rainfall between 1900 and 2017 from version 5.01 of Willmott and Matsuura (2001). For births that are no later than 2017 and for which the survey cluster has valid coordinates, we record annual rainfall in the first year of life at the grid point nearest to the survey cluster. We use these data to estimate:

$$
\begin{aligned}
Mortality_{iemt} =& \alpha + \beta_1 Rain_{iemt} \times Twin_{iemt} \times TwinKilling_e \\
& + \beta_2 Rain_{iemt} \times TwinKilling_e + \beta_3 Rain_{iemt} \times Twin_{iemt} \\
& + \beta_4 Twin_{iemt} \times TwinKilling_e \\
& + \beta_5 Rain_{iemt} + \beta_6 Twin_{iemt} + \beta_7 TwinKilling_e \\
& + x'_{iemt}\gamma + \delta_c + \eta_t + \epsilon_{iemt}
\end{aligned}
$$
(4)

While many variables are defined as in Equation (1), there are new terms. $Rain_{iemt}$ is annual rainfall in the survey cluster in the child's year of birth. Controls x_{iemt} are now restricted to a female dummy and birth order. Our fixed effects δ_c and η_t are now for survey cluster and year of birth. This specification, then, exploits the panel-like variation in the data, so that $Rain_{iemt}$ can be interpreted as the impact of an exogenous rainfall shock, since identification is now based of deviations from cluster and year means. The coefficient of interest is β_1, which captures the degree to which any mortality penalty

for twins relative to non-twins that is greater in formerly twin-killing societies becomes greater or smaller if rainfall is more or less abundant. If droughts were to activate dormant attitudes that lessen twin survival, we would expect β_1 to be negative. Table A17 shows that this is not the case; while greater rainfall reduces child mortality, this is not different across twins and non-twins, and it does not differ by past tradition or its interaction with twin.

4.5. **Additional results and robustness.** In the remainder of this section, we briefly outline additional results and robustness checks that we have omitted from the main text for space. In Table A18 we show that the results presented in Table 5 are similar if we code twin killing by location in the (Murdock, 1959) map, rather than DHS ethnicity.

In Table A19, we report alternative versions of our subsample analysis by distance from a colonial mission. In columns (1) through (3), we report results in the border sample. The greater relative mortality rate of twins relative to non-twins among formerly twin-killing societies distant from missions remains. This gap continues to be driven by distance from Protestant missions, though the differential is no longer significant with mother fixed effects. In columns (4) through (6) we code twin-killing by location in the Murdock (1959) map, rather than DHS ethnicity. Here, the results are qualitatively similar to those in Table 7, though they are not always statistically significant.

In Tables A20, A21, A22, and A23, we consider heterogeneity by colonizer in alternative samples or with alternative codings. In Table A20, we show results in the border sample. Here, the interaction of $Twin \times TwinKilling$ remains positive and significant in the French sub-sample with child mortality as an outcome in specifications without mother fixed effects. Restricting the sample to twins only and estimating Equation (2), the absolute mortality penalty for twins is greater among formerly twin-killing societies in former French colonies. A positive and significant differential also appears for the infant mortality of twins in the "other" category. Restricting the twin sample to the border sample in Table A22, the interaction of $Twin \times TwinKilling$ is again positive and significant in the French sub-sample, except in the case of child mortality with mother fixed effects.

5. CONCLUSION

While the mortality of twins is high in Africa in the present, we have found no evidence that a tradition of twin infanticide in many parts of the continent contributes to this. We have taken three approaches to assessing whether mortality of twins is higher in the present, relative to that of non-twins, among African societies that previously practiced twin infanticide. Our results suggest no effect of a former tradition of twin infanticide on twin mortality in Africa in the present. Twin infanticide and its indirect legacies have

been suppressed through a mix of African and external forces, including cultural diffusion and missionary enterprise. We show that, where these channels of suppression are weak – distant from colonial missions and authority, and in former French colonies – there is evidence that twin mortality remains elevated among formerly twin-killing groups.

These results contrast, then, with many other results in the literature that show considerable persistence in culture, including among migrant populations. These include past histories of selective infanticide that continue to influence sex ratios in East and South Asia (Lee and Wang, 2001; Sudha and Rajan, 1999). Other notable examples of historical persistence in culture include gender norms, trust, and individualism (Alesina, Giuliano and Nunn, 2013; Bazzi, Fiszbein and Gebresilasse, 2020; Becker, 2019; Xue, 2018). And yet the literature has noted cases in which culture has changed rapidly. Fernández (2011), for example, cites attitudes in the United States towards women working outside the home and towards premarital sex, explaining these changes using the presence of multiple equilibria and endogenous learning. Voigtländer and Voth (2012), similarly, note that the transmission of anti-Semitism across generations in Germany was attenuated by trade and mobility.

The suppression of twin infanticide and its indirect legacies by African and external forces has several common features with these cases of change, and differences with cases of persistence. The reverence for twins in some societies and abhorrence of twins in others provides more variation in attitudes than does the existence or absence of a preference for sons. The prevalence of adjacent ethnic groups with very different attitudes towards twins facilitated the transmission of *culture*. Missions that fought twin infanticide induced permanent cultural change; Christianity is now the most common religion in sub-Saharan Africa, and this has led to lasting changes in other areas, including health and sexual behaviour (Cagé and Rueda, 2017). Efforts of *institutions* such as colonial courts against infanticide did not involve the same trauma as other colonial interventions such as medical campaigns and natural resource extraction that have left legacies of distrust (Lowes and Montero, 2020, 2018). The status of twins is not as central as the status of women is to other equilibria involving marriage, inheritance, and the division of labour, and so changing the status of twins does not necessarily entail wide-ranging changes in other domains. Once twin infanticide had been suppressed, the existence of *multiple equilibria* inhibited its return, as individuals adhered to new social norms (Marroquín and Haight, 2017).

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	(1)	(2)	(3)	(4)	(5)
	Mean	s.d.	Min	Max	N
Infant Mortality	0.075	0.26	0	1	1.02e+06
Child Mortality	0.12	0.33	0	1	1.02e+06
Twin Killing (DHS)	0.28	0.45	0	1	827,525
Twin Killing (Murdock)	0.25	0.43	0	1	759,610
Twin	0.033	0.18	0	1	1.01e+06
Birth Order	3.30	2.23	1	18	1.02e+06
Year of Birth	2,002	8.77	1,958	2,018	1.02e+06
Female	0.49	0.50	0	1	1.02e+06
Border Sample	0.40	0.49	0	1	1.00e+06

Table 1. Summary Statistics

Table 2. Full Sample Results

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
Panel A. Twin Killing Coded by DHS Ethnicity						
Twin X TwinKilling	0.003	0.003	0.003	0.007	0.009	0.007
	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)	(0.011)
Twin	0.171***	0.173***	0.184***	0.180***	0.183***	0.198***
	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)
TwinKilling	-0.004	0.000		-0.014	-0.004	
	(0.004)	(0.002)		(0.010)	(0.002)	
Observations	827,065	827,065	788,399	827,065	827,065	788,399
Outcome Mean	0.0740	0.0738	0.0754	0.123	0.123	0.126
Panel B. Twin Killing Coded by Murdock Ethnicity						
Twin X TwinKilling	-0.003	-0.003	-0.001	-0.003	-0.002	0.002
	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)	(0.010)
Twin	0.176***	0.177***	0.188***	0.186***	0.188***	0.202***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
TwinKilling	-0.007**	-0.001		-0.019**	-0.002	
	(0.004)	(0.002)		(0.009)	(0.003)	
Observations	759,183	759,183	722,651	759,183	759,183	722,651
Outcome Mean	0.0737	0.0737	0.0751	0.121	0.121	0.124
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by the DHS ethnicity in Panel A, and Murdock Ethnicity in Panel B. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
Panel A. Twin Killing Coded by DHS Ethnicity						
Twin X TwinKilling	-0.000	-0.000	0.002	0.010	0.010	0.012
	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)
Twin	0.163***	0.164***	0.174***	0.174***	0.177***	0.186***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
TwinKilling	-0.000	0.000		-0.006	-0.002	
	(0.004)	(0.002)		(0.008)	(0.003)	
Observations	337,534	337,534	321,641	337,534	337,534	321,641
Outcome Mean	0.0686	0.0686	0.0698	0.114	0.114	0.117
Panel B. Twin Killing Coded by Murdock Ethnicity						
Twin X TwinKilling	0.001	0.001	0.003	0.001	0.001	0.004
	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)	(0.013)
Twin	0.167***	0.168***	0.180***	0.182***	0.184***	0.196***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
TwinKilling	-0.001	-0.002		-0.005	-0.002	
	(0.003)	(0.002)		(0.006)	(0.003)	
Observations	331,891	331,891	315,989	331,891	331,891	315,989
Outcome Mean	0.0677	0.0677	0.0688	0.111	0.111	0.114
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 3. Border Sample Results

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by the DHS ethnicity in Panel A, and Murdock Ethnicity in Panel B. Controls are female, birth order, and year of birth.

Table 4. Twin Sample Results

	(1)	(2)	(3)	(4)
	Infant Mortality		Child Mortality	
Panel A. Twin Killing Coded by DHS Ethnicity: Full Sample				
TwinKilling	0.008	0.012	0.000	0.019*
	(0.014)	(0.011)	(0.020)	(0.011)
Observations	27,186	27,186	27,186	27,186
Outcome Mean	0.241	0.241	0.299	0.299
Panel B. Twin Killing Coded by Murdock Ethnicity: Full Sample				
TwinKilling	-0.002	-0.002	-0.020	-0.004
	(0.013)	(0.012)	(0.019)	(0.014)
Observations	25,198	25,198	25,198	25,198
Outcome Mean	0.243	0.243	0.300	0.300
Panel C. Twin Killing Coded by DHS Ethnicity: Border Sample				
TwinKilling	0.011	0.001	0.016	0.018
	(0.014)	(0.013)	(0.018)	(0.013)
Observations	10,916	10,916	10,916	10,916
Outcome Mean	0.226	0.226	0.286	0.286
Panel D. Twin Killing Coded by Murdock Ethnicity: Border Sample				
TwinKilling	0.008	-0.008	0.001	-0.012
	(0.013)	(0.012)	(0.015)	(0.015)
Observations	10,648	10,648	10,648	10,648
Outcome Mean	0.230	0.230	0.288	0.288
Country Fixed Effects	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	No	Yes
Mother Fixed Effects	No	No	No	No
Controls	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by the DHS ethnicity in Panel A, and Murdock Ethnicity in Panel B. Controls are female, birth order, and year of birth.

Table 5. Investments in Children

	(1)	(2)	(3)	(4)	(5)
	Received bcg	Received polio 0	Received measles	Number of polio 1 to 3 vaccines received	Number of DPT 1 to 3 vaccines received
Twin X TwinKilling (DHS)	0.006	0.024	-0.015	0.004	0.033
	(0.014)	(0.000)	(0.016)	(0.043)	(0.047)
Controls + Country FE	Yes	Yes	Yes	Yes	Yes
Observations	179,521	179,651	178,713	178,576	178,663
Mean of Dependent Variable	0.815	0.657	0.602	2.179	2.090
	(6)	(7)	(8)	(9)	(10)
	Number of vaccines received	Months of breastfeeding	Below Median months of Breastfeeding	Place of delivery: home	Assistance: doctor
Twin X TwinKilling (DHS)	0.031	-0.182	0.003	-0.007	0.025*
	(0.092)	(0.504)	(0.027)	(0.000)	(0.015)
Controls + Country FE	Yes	Yes	Yes	Yes	Yes
Observations	176,756	103,535	103,535	215,086	216,456
Mean of Dependent Variable	4.881	11.63	0.503	0.403	0.0823
	(11)	(12)	(13)	(14)	(15)
	Weight/Height percentile	Weight/Age percentile	Height/Age percentile	Birth weight in kilograms (3 decimals)	Size of child at birth
Twin X TwinKilling (DHS)	190.082	117.134	102.793	8.549	-0.035
	(119.106)	(120.502)	(134.059)	(47.955)	(0.045)
Controls + Country FE	Yes	Yes	Yes	Yes	Yes
Observations	129,721	128,590	128,590	103,497	203,552
Mean of Dependent Variable	3775	2397	2479	3199	2.738

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by the DHS ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Table 6. Results for births before 1980					
	Infant Mortality			Child Mortality		
Panel A. Full Sample						
Twin X TwinKilling (DHS)	0.062**	0.061**	0.060**	0.059**	0.058**	0.054**
	(0.030)	(0.030)	(0.030)	(0.025)	(0.025)	(0.024)
Twin	0.274***	0.273***	0.277***	0.273***	0.272***	0.277***
	(0.016)	(0.016)	(0.015)	(0.015)	(0.015)	(0.014)
TwinKilling (DHS)	0.007	0.006	0.001	-0.011	-0.011	-0.013**
	(0.007)	(0.007)	(0.004)	(0.009)	(0.009)	(0.005)
Observations	94,032	94,030	94,017	94,032	94,030	94,017
Mean of Dependent Variable	0.141	0.141	0.141	0.261	0.261	0.261
Panel B. Twins Sample						
TwinKilling (DHS)	0.080**	0.074**	0.032	0.057*	0.053*	0.007
	(0.031)	(0.031)	(0.047)	(0.029)	(0.028)	(0.033)
Observations	2,536	2,536	2,536	2,536	2,536	2,536
Mean of Dependent Variable	0.417	0.417	0.417	0.534	0.534	0.534
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Dataset Fixed Effects	No	Yes	Yes	No	Yes	Yes
Dataset X Region Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

Table 7. Results for subsamples distant from missions

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
Panel A: Above-median distance from mission						
Twin X TwinKilling (DHS)	0.030**	0.029**	0.025	0.041***	0.041***	0.032**
	(0.014)	(0.014)	(0.017)	(0.014)	(0.014)	(0.015)
Observations	389,856	389,856	374,630	389,856	389,856	374,630
Mean of Dependent Variable	0.0835	0.0835	0.0847	0.144	0.144	0.147
Panel B: Above-median distance from Protestant mission						
Twin X TwinKilling (DHS)	0.032**	0.032**	0.028*	0.042***	0.042***	0.033**
	(0.014)	(0.014)	(0.016)	(0.014)	(0.013)	(0.015)
Observations	390,547	390,547	375,191	390,547	390,547	375,191
Mean of Dependent Variable	0.0829	0.0829	0.0841	0.143	0.143	0.146
Panel C: Protestant mission > 25 km						
Twin X TwinKilling (DHS)	0.019	0.020*	0.014	0.023*	0.025**	0.016
	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.013)
Observations	614,161	614,161	588,691	614,161	614,161	588,691
Mean of Dependent Variable	0.0783	0.0783	0.0795	0.132	0.132	0.135
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

Table 8. Results for subsamples distant from cities in 1960

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
Panel A: Above-median distance from city						
Twin X TwinKilling (DHS)	0.024**	0.024**	0.023*	0.027**	0.028**	0.019
	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)
Observations	390,922	390,922	374,006	390,922	390,922	374,006
Mean of Dependent Variable	0.0733	0.0733	0.0744	0.120	0.120	0.122
Panel B: Below-median distance from city						
Twin X TwinKilling (DHS)	-0.013	-0.013	-0.013	-0.007	-0.005	-0.002
	(0.013)	(0.013)	(0.015)	(0.013)	(0.014)	(0.015)
Observations	425,102	425,101	403,755	425,102	425,101	403,755
Mean of Dependent Variable	0.0747	0.0747	0.0764	0.126	0.126	0.129
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
British Africa						
Twin X TwinKilling	-0.014	-0.014	-0.015	-0.013	-0.011	-0.012
	(0.013)	(0.013)	(0.015)	(0.014)	(0.014)	(0.015)
Observations	386,408	386,408	368,152	386,408	386,408	368,152
Outcome Mean	0.0708	0.0708	0.0722	0.115	0.115	0.118
French Africa						
Twin X TwinKilling	0.021	0.023	0.016	0.036**	0.039***	0.027*
	(0.017)	(0.017)	(0.019)	(0.015)	(0.015)	(0.016)
Observations	365,274	365,274	349,125	365,274	365,274	349,125
Outcome Mean	0.0757	0.0757	0.0769	0.131	0.131	0.134
Other (Ethiopia, Liberia, Mozambique and Namibia) Africa						
Twin X TwinKilling	-0.002	-0.002	0.012	-0.006	-0.006	0.015
	(0.029)	(0.029)	(0.031)	(0.026)	(0.025)	(0.028)
Observations	75,383	75,383	71,122	75,383	75,383	71,122
Outcome Mean	0.0825	0.0825	0.0843	0.121	0.121	0.124
Fixed Effects	Country	Region	Mother	Country	Country	Country
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 9. Results by Colonizer

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by ethnicity. Controls are female, birth order, and year of birth.

APPENDIX A. EXPLANATION OF RECODES

In Table A6, we show robustness to several recodes of our $TwinKilling$ variable. We list these below, alongside an explanation for the recoding:

- *Recode Akan as 1*: Although twins were generally not killed, twins born into the royal family were killed (Manoukian, 2017, p. 51).
- *Recode Ana-Ife as 1*: While Lagercrantz (1941, p. 45) states that the Atakpame do not kill twins, they are a sub-group of the Yoruba, who are widely known to have had a tradition of twin infanticide in the past (e.g. Ball and Hill (1996)).
- *Recode Arab Choa as 1*: The Cameroonian DHS survey combines together several groups that have different codings: Arab-Choa, Peulh, Haoussa, and Kanuri.
- *Recode Bukusu as 1*: While Lagercrantz (1941, p. 98) states that the Bukusu do not kill twins, Wekesa (2015) reports otherwise.
- *Recode Chewa as 1*: While Hodgson (1933) reports that twin infanticide is absent, Lagercrantz (1941, p. 152) reports its presence among the Nyanja (an alternative name).
- *Recode Eshan as 1*: While Lagercrantz (1941, p. 50) reports that twin infanticide is absent, contrary evidence on the Esan comes from (Jamgbadi, N.d.), which describes a folk tale.
- *Recode Ga as 1*: While Manoukian (2017) reports that twin infanticide is absent, Lagercrantz (1941, p. 28) reports its presence among Krobo subgroup.
- *Recode Mossi as 1*: While Table 1 of Granzberg (1973) codes twin infanticide as absent, several sources, including Lagercrantz (1941, p. 24), reports it as present.
- *Recode Senoufo as 1*: While Knops (1938, p. 484) and Lagercrantz (1941, p. 22) report twin infanticide as absent, Bah and Fanny (2018, p. 101) report it as present.
- *Recode Amhara as 0*: While Table 1 of Granzberg (1973) reports twin infanticide as present, Lagercrantz (1941, p. 78), reports it as absent.
- *Recode Azande as 0*: The DHS for the Central African Republic report the Zande-Nzakara as a single group. Peek (2011, p. 193) reports twin infanticide as present among the Nzakara, while Table 2 of Ball and Hill (1996), reports it as absent.
- *Recode Damara Nama as 0*: Lagercrantz (1941, p. 171-2) reports twin infanticide as present among the Damara but absent among the Nama. The DHS data for Namibia combine these groups.
- *Recode Fulani as 0*: Lagercrantz (1941, p. 65) reports twin infanticide as present, while Harris (1930) reports it is absent.
- *Recode Ganda as 0*: While Lagercrantz (1941, p. 120) reports twin infanticide as present, Table 1 of Ball and Hill (1996) reports it as absent.

- *Recode Lozi as 0*: Ball and Hill (1996) note that evidence on the Lozi is contradictory.
- *Recode Lunda as 0*: While Table 1 of Ball and Hill (1996) reports twin infanticide as present, Mutunda (2011), reports it as absent.
- *Recode Margi as 0*: Vaughan Jr (2000, p. 261-2) reports contradictory information.
- *Recode Mijikenda as 0*: While Lagercrantz (1941, p. 128) and other sources report twin infanticide as present among the Mijikenda, he reports it as absent for the Swahili (p. 131). The Kenyan DHS data merges these two groups.
- *Recode Oron as 0*: Our only evidence is from Simmons (1960), who argues that twin infanticide may be inferred on the basis of proverbs.
- *Recode Sierra Leone as 0*: Thomas (1916) makes a blanket statement that the birth of twins is regarded as a joyful event throughout Sierra Leone.
- *Recode Tiv as 0*: While Downes (1933) reports twin infanticide as present, several other documents in the Human Relations Area Files claim otherwise.
- *Recode Turkana as 0*: While Lagercrantz (1941, p. 93) reports twin infanticide as present, Emley (1927) reports it as absent.
- *Recode Yao as 0*: Lagercrantz (1941, p. 142) reports twin infanticide as present, but only among one Yao sub-group.
- *Recode Yoruba as 0*: Oral tradition suggests that twin infanticide among the Yoruba was abolished by the Alafin Ajaka during the twelfth century (Chappel, 1974, p. 252).
- *Recode Dagara as Missing*: Our only evidence is a claim by Kyiileyang (2019, p. 601) that twins are given special names.
- *Recode Wurkum as Missing*: Our only evidence is a claim by Adelberger (1993, p. 7) that carved wooden ritual objects serve as spiritual protective devices after unusual births such as twins or breech births.

APPENDIX B. ADDITIONAL TABLES

(1)	(2)	(3)	(4)
Variable	β	(s.e.)	N
Share Altimontane Vegetation	-1.949	(1.795)	543
Share Azonal Vegetation	-0.114	(0.230)	543
Share Bushland And Thicket	-0.047	(0.089)	543
Share Bushland And Thicket Mosaics	-0.075	(0.295)	543
Share Cape Shrubland	-314.742	(355.041)	543
Share Desert	-0.232	(0.165)	543
Share Edaphic Grassland Mosaics	0.230	(0.223)	543
Share Forest	-0.149**	(0.067)	543
Share Forest Transitions And Mosaics	-0.083	(0.062)	543
Share Grassland	-0.141	(0.492)	543
Share Secondary Wooded Grassland	-5.525	(5.899)	543
Share Semi-Desert Vegetation	-0.098	(0.158)	543
Share Water	-1.596*	(0.964)	543
Share Woodland	0.169***	(0.050)	543
Share Woodland Mosaics And Transitions	0.340*	(0.194)	543
Colonial Railroad	-0.198***	(0.066)	543
Explorer Route	-0.156***	(0.045)	543
River	-0.107**	(0.043)	543
Caloric Suitability N(0,1)	0.064***	(0.021)	543
ln Slave Exports per unit area N(0,1)	-0.089***	(0.021)	543
Altitude N(0,1)	-0.012	(0.021)	543
Pasture N(0,1)	-0.082***	(0.021)	543
Forest N(0,1)	-0.071***	(0.021)	543
Precipitation N(0,1)	-0.038*	(0.021)	543
Slope N(0,1)	-0.011	(0.021)	543
Temperature N(0,1)	0.053**	(0.021)	543
Humidity N(0,1)	-0.086***	(0.021)	543
Distance from Coast N(0,1)	0.052**	(0.021)	543
TseTse Suitability N(0,1)	0.001	(0.021)	543
Sorghum Suitability FAO N(0,1)	0.096***	(0.021)	543
Wheat Suitability FAO N(0,1)	-0.016	(0.021)	543
Wetland Rice Suitability FAO N(0,1)	-0.034	(0.021)	543
Yam Suitability FAO N(0,1)	-0.003	(0.021)	543
Tomato Suitability FAO N(0,1)	0.027	(0.021)	543
Cotton Suitability FAO N(0,1)	0.065***	(0.021)	543
Pearl Millet Suitability FAO N(0,1)	0.097***	(0.021)	543
White Potato Suitability FAO N(0,1)	-0.016	(0.021)	543
Barley Suitability FAO N(0,1)	-0.015	(0.021)	543
Coffee Suitability FAO N(0,1)	-0.086***	(0.021)	543
Bean Suitability FAO N(0,1)	0.089***	(0.021)	543
Pulses Suitability FAO N(0,1)	0.070***	(0.021)	543
Oil Palm Suitability FAO N(0,1)	-0.052**	(0.021)	543
Citrus Suitability FAO N(0,1)	-0.052**	(0.021)	543
Chickpea Suitability FAO N(0,1)	-0.023	(0.021)	543

Table A1. Correlates of Missing Data

Table A1. Correlates of Missing Data

(1)	(2)	(3)	(4)
Variable	β	(s.e.)	N
Share Altimontane Vegetation	-1.949	(1.795)	543
Share Azonal Vegetation	-0.114	(0.230)	543
Share Bushland And Thicket	-0.047	(0.089)	543
Share Bushland And Thicket Mosaics	-0.075	(0.295)	543
Share Cape Shrubland	-314.742	(355.041)	543
Share Desert	-0.232	(0.165)	543
Share Edaphic Grassland Mosaics	0.230	(0.223)	543
Share Forest	-0.149**	(0.067)	543
Share Forest Transitions And Mosaics	-0.083	(0.062)	543
Share Grassland	-0.141	(0.492)	543
Share Secondary Wooded Grassland	-5.525	(5.899)	543
Share Semi-Desert Vegetation	-0.098	(0.158)	543
Share Water	-1.596*	(0.964)	543
Share Woodland	0.169***	(0.050)	543
Share Woodland Mosaics And Transitions	0.340*	(0.194)	543
Colonial Railroad	-0.198***	(0.066)	543
Explorer Route	-0.156***	(0.045)	543
River	-0.107**	(0.043)	543
Caloric Suitability N(0,1)	0.064***	(0.021)	543
ln Slave Exports per unit area N(0,1)	-0.089***	(0.021)	543
Altitude N(0,1)	-0.012	(0.021)	543
Pasture N(0,1)	-0.082***	(0.021)	543
Forest N(0,1)	-0.071***	(0.021)	543
Precipitation N(0,1)	-0.038*	(0.021)	543
Slope N(0,1)	-0.011	(0.021)	543
Temperature N(0,1)	0.053**	(0.021)	543
Humidity N(0,1)	-0.086***	(0.021)	543
Distance from Coast N(0,1)	0.052**	(0.021)	543
TseTse Suitability N(0,1)	0.001	(0.021)	543
Sorghum Suitability FAO N(0,1)	0.096***	(0.021)	543
Wheat Suitability FAO N(0,1)	-0.016	(0.021)	543
Wetland Rice Suitability FAO N(0,1)	-0.034	(0.021)	543
Yam Suitability FAO N(0,1)	-0.003	(0.021)	543
Tomato Suitability FAO N(0,1)	0.027	(0.021)	543
Cotton Suitability FAO N(0,1)	0.065***	(0.021)	543
Pearl Millet Suitability FAO N(0,1)	0.097***	(0.021)	543
White Potato Suitability FAO N(0,1)	-0.016	(0.021)	543
Barley Suitability FAO N(0,1)	-0.015	(0.021)	543
Coffee Suitability FAO N(0,1)	-0.086***	(0.021)	543
Bean Suitability FAO N(0,1)	0.089***	(0.021)	543
Pulses Suitability FAO N(0,1)	0.070***	(0.021)	543
Oil Palm Suitability FAO N(0,1)	-0.052**	(0.021)	543
Citrus Suitability FAO N(0,1)	-0.052**	(0.021)	543
Chickpea Suitability FAO N(0,1)	-0.023	(0.021)	543

Coconut Suitability FAO N(0,1)	-0.059***	(0.021)	543
Sweet Potato Suitability FAO N(0,1)	0.049**	(0.021)	543
Cow Pea Suitability FAO N(0,1)	0.076***	(0.021)	543
Groundnut Suitability FAO N(0,1)	0.084***	(0.021)	543
Dry Rice Suitability FAO N(0,1)	0.001	(0.021)	543
Maize Suitability FAO N(0,1)	0.070***	(0.021)	543
Nomadic Pastoralism Suitability N(0,1)	0.012	(0.021)	543
Cassava Suitability FAO N(0,1)	-0.018	(0.021)	543
Ruggedness N(0,1)	0.019	(0.021)	543
Malaria N(0,1)	0.066***	(0.021)	543
Population Density GPW N(0,1)	-0.053**	(0.021)	543
Banana Suitability FAO N(0,1)	-0.084***	(0.021)	543
ln Population Density 1500 N(0,1)	0.011	(0.021)	543
ln Population Density 1900 N(0,1)	0.023	(0.021)	543
ln Area N(0,1)	-0.132***	(0.021)	543
Conflicts in Brecke per unit area N(0,1)	-0.022	(0.021)	543
Mines per unit area N(0,1)	-0.029	(0.021)	543
Missions per unit area N(0,1)	-0.070***	(0.021)	543
Catholic Missions per unit area N(0,1)	-0.074***	(0.021)	543
Protestant Missions per unit area N(0,1)	-0.055***	(0.021)	543
HYDE Population Density X Murdock Area N(0,1)	-0.097***	(0.021)	543
Absolute Latitude N(0,1)	0.029	(0.021)	543
Ecological Diversity N(0,1)	-0.058***	(0.021)	543
Agriculture	0.025*	(0.014)	360
Polygynous	-0.079	(0.123)	351
Jurisdictional Hierarchy	-0.042	(0.028)	333
Patrilineal	0.047	(0.057)	350
Female Participation in Agriculture	-0.041*	(0.024)	209

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Robust standard errors in parentheses. Each row is a regression of whether data on twin infanticide is missing on a variable measured using the Murdock (1959) map.

Table A2. Balance Tests

(1)	(2)	(3)	(4)
Variable	β	(s.e.)	N
Share Altimontane Vegetation	1.947	(1.846)	304
Share Azonal Vegetation	0.343	(0.268)	304
Share Bushland And Thicket	0.016	(0.104)	304
Share Bushland And Thicket Mosaics	0.383	(0.347)	304
Share Cape Shrubland	520.602	(318.163)	304
Share Desert	-0.170	(0.171)	304
Share Edaphic Grassland Mosaics	0.331	(0.277)	304
Share Forest	-0.084	(0.079)	304
Share Forest Transitions And Mosaics	0.044	(0.075)	304
Share Grassland	-0.442	(0.512)	304
Share Secondary Wooded Grassland	-3.432	(5.307)	304
Share Semi-Desert Vegetation	0.154	(0.182)	304
Share Water	-0.263	(0.939)	304
Share Woodland	-0.032	(0.065)	304
Share Woodland Mosaics And Transitions	0.176	(0.292)	304
Colonial Railroad	0.231***	(0.070)	304
Explorer Route	-0.018	(0.052)	304
River	0.082	(0.053)	304
Caloric Suitability N(0,1)	0.019	(0.024)	304
ln Slave Exports per unit area N(0,1)	0.023	(0.021)	304
Altitude N(0,1)	-0.033	(0.026)	304
Pasture N(0,1)	0.001	(0.025)	304
Forest N(0,1)	-0.014	(0.024)	304
Precipitation N(0,1)	-0.019	(0.024)	304
Slope N(0,1)	0.060**	(0.026)	304
Temperature N(0,1)	-0.034	(0.025)	304
Humidity N(0,1)	0.026	(0.025)	304
Distance from Coast N(0,1)	-0.068***	(0.025)	304
TseTse Suitability N(0,1)	0.011	(0.025)	304
Sorghum Suitability FAO N(0,1)	0.028	(0.025)	304
Wheat Suitability FAO N(0,1)	0.007	(0.027)	304
Wetland Rice Suitability FAO N(0,1)	-0.026	(0.025)	304
Yam Suitability FAO N(0,1)	0.013	(0.024)	304
Tomato Suitability FAO N(0,1)	0.013	(0.024)	304
Cotton Suitability FAO N(0,1)	0.028	(0.024)	304
Pearl Millet Suitability FAO N(0,1)	0.047*	(0.026)	304
White Potato Suitability FAO N(0,1)	0.003	(0.027)	304
Barley Suitability FAO N(0,1)	0.004	(0.027)	304
Coffee Suitability FAO N(0,1)	-0.016	(0.025)	304
Bean Suitability FAO N(0,1)	0.031	(0.025)	304
Pulses Suitability FAO N(0,1)	0.030	(0.024)	304
Oil Palm Suitability FAO N(0,1)	0.004	(0.026)	304
Citrus Suitability FAO N(0,1)	0.020	(0.025)	304
Chickpea Suitability FAO N(0,1)	0.015	(0.024)	304

Coconut Suitability FAO N(0,1)	0.036	(0.025)	304
Sweet Potato Suitability FAO N(0,1)	0.026	(0.024)	304
Cow Pea Suitability FAO N(0,1)	0.039	(0.025)	304
Groundnut Suitability FAO N(0,1)	0.042	(0.025)	304
Dry Rice Suitability FAO N(0,1)	0.001	(0.024)	304
Maize Suitability FAO N(0,1)	0.019	(0.025)	304
Nomadic Pastoralism Suitability N(0,1)	-0.032	(0.027)	304
Cassava Suitability FAO N(0,1)	0.006	(0.025)	304
Ruggedness N(0,1)	0.006	(0.028)	304
Malaria N(0,1)	-0.004	(0.025)	304
Population Density GPW N(0,1)	0.017	(0.021)	304
Banana Suitability FAO N(0,1)	-0.031	(0.025)	304
ln Population Density 1500 N(0,1)	-0.011	(0.023)	304
ln Population Density 1900 N(0,1)	0.022	(0.023)	304
ln Area N(0,1)	0.034	(0.025)	304
Conflicts in Brecke per unit area N(0,1)	-0.013	(0.020)	304
Mines per unit area N(0,1)	-0.008	(0.021)	304
Missions per unit area N(0,1)	0.036*	(0.022)	304
Catholic Missions per unit area N(0,1)	-0.008	(0.021)	304
Protestant Missions per unit area N(0,1)	0.050**	(0.022)	304
HYDE Population Density X Murdock Area N(0,1)	0.057***	(0.020)	304
Absolute Latitude N(0,1)	0.057**	(0.023)	304
Ecological Diversity N(0,1)	0.040	(0.026)	304
Agriculture	-0.020	(0.016)	228
Polygynous	0.163	(0.151)	224
Jurisdictional Hierarchy	0.051	(0.032)	218
Patrilineal	-0.094	(0.064)	225
Female Participation in Agriculture	0.038	(0.027)	147

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Robust standard errors in parentheses. Each row is a regression of the presence of twin infanticide on a variable measured using the Murdock (1959) map.

	(1)	(2)	(3)	(4)	(5)	(6)
	Table A3. Full Sample Results With Additional Controls					
	Infant Mortality			Child Mortality		
Panel A. Twin Killing Coded by DHS Ethnicity						
Twin X TwinKilling	-0.011	0.004	0.003	-0.006	0.010	0.010
	(0.010)	(0.010)	(0.011)	(0.011)	(0.010)	(0.012)
Twin	0.170***	0.171***	0.170***	0.180***	0.180***	0.181***
	(0.007)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)
TwinKilling	-0.007**	-0.001	-0.002	-0.022***	-0.010	-0.010
	(0.003)	(0.002)	(0.003)	(0.008)	(0.006)	(0.006)
Observations	595,717	827,027	753,351	595,717	827,027	753,351
Outcome Mean	0.0734	0.0740	0.0751	0.121	0.123	0.125
Panel B. Twin Killing Coded by Murdock Ethnicity						
Twin X TwinKilling	-0.012	-0.002	-0.008	-0.008	-0.002	-0.007
	(0.011)	(0.009)	(0.010)	(0.012)	(0.010)	(0.010)
Twin	0.177***	0.175***	0.176***	0.185***	0.185***	0.188***
	(0.007)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)
TwinKilling	-0.009**	-0.003	-0.006**	-0.023**	-0.012*	-0.014**
	(0.004)	(0.002)	(0.003)	(0.009)	(0.006)	(0.006)
Observations	527,766	759,153	700,840	527,766	759,153	700,840
Outcome Mean	0.0738	0.0737	0.0749	0.121	0.121	0.124
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	No	No	No	No	No
Mother Fixed Effects	No	No	No	No	No	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Ethnographic	Maternal	Geographic	Ethnographic	Maternal	Geographic

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by the DHS ethnicity in Panel A, and Murdock Ethnicity in Panel B. Controls are female, birth order, and year of birth. Ethnographic controls are the importance of agriculture, polygamy, jurisdictional hierarchy, patriliny, and female participation in agriculture. Maternal controls are maternal age, maternal age squared, rural, mother's level of education, mother's religion. Geographic controls are precipitation, aridity, temperature, vegetation, and malaria incidence.

Table A4. Results Controlling for Variables Significant in Table A2

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
Panel A. Twin Killing Coded by DHS Ethnicity						
Twin X TwinKilling	0.004	0.004	0.004	0.010	0.010	0.009
	(0.010)	(0.010)	(0.012)	(0.010)	(0.010)	(0.011)
Twin	0.172***	0.172***	0.183***	0.181***	0.183***	0.197***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
TwinKilling	-0.001	0.000		-0.009*	-0.004	
	(0.002)	(0.002)		(0.005)	(0.002)	
Observations	808,613	808,613	770,801	808,613	808,613	770,801
Outcome Mean	0.0742	0.0742	0.0756	0.123	0.123	0.126
Panel B. Twin Killing Coded by Murdock Ethnicity						
Twin X TwinKilling	-0.002	-0.003	-0.001	-0.001	-0.002	0.002
	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)	(0.010)
Twin	0.176***	0.177***	0.188***	0.187***	0.188***	0.202***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
TwinKilling	-0.002	-0.001		-0.008	-0.001	
	(0.002)	(0.002)		(0.005)	(0.003)	
Observations	759,183	759,183	722,651	759,183	759,183	722,651
Outcome Mean	0.0737	0.0737	0.0751	0.121	0.121	0.124
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by the DHS ethnicity in Panel A, and Murdock Ethnicity in Panel B. Controls are female, birth order, and year of birth, as well as colonial railroad, slope, coast distance, pearl millet suitability, missions per unit area, protestant, missions per unit area, estimated population in 1900, and absolute latitude.

	(1)	(2)	(3)	(4)
	Child Mortality			
Panel A. Twin Killing Coded by DHS Ethnicity				
Twin X TwinKilling	0.010	0.010	0.012	-0.002
	(0.012)	(0.012)	(0.010)	(0.016)
Observations	337,534	337,534	555,218	173,187
Outcome Mean	0.114	0.114	0.115	0.119
Panel B. Twin Killing Coded by Murdock Ethnicity				
Twin X TwinKilling	0.001	0.001	0.004	0.007
	(0.012)	(0.012)	(0.010)	(0.016)
Observations	331,891	331,891	532,750	180,614
Outcome Mean	0.111	0.111	0.113	0.117
Alternative specification	Linear polynomial in distance to border	Control for latitude and longitude	200 km bandwidth	50 km bandwidth
Fixed Effects	Country	Country	Country	Country
Controls	Yes	Yes	Yes	Yes

Table A5. Alternative Border Specifications

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by the DHS ethnicity in Panel A, and Murdock Ethnicity in Panel B. Controls are female, birth order, and year of birth.

Table A6. Alternative Codings

(1) Variable	(2) β	(3) (s.e.)	(4) N
Recode Akan as 1	0.007	(0.010)	827,065
Recode Ana-Ife as 1	0.008	(0.010)	827,065
Recode Arab Choa as 1	0.008	(0.010)	827,065
Recode Bukusu as 1	0.007	(0.010)	827,065
Recode Chewa as 1	0.005	(0.010)	827,065
Recode Esan as 1	0.007	(0.010)	827,065
Recode Ga as 1	0.006	(0.010)	827,065
Recode Mossi as 1	0.007	(0.010)	827,065
Recode Senoufo as 1	0.010	(0.010)	827,065
Recode Amhara as 0	0.005	(0.010)	827,065
Recode Azande as 0	0.007	(0.010)	827,065
Recode Damara Nama as 0	0.006	(0.010)	827,065
Recode Fulani as 0	-0.006	(0.010)	827,065
Recode Ganda as 0	0.009	(0.010)	827,065
Recode Lozi as 0	0.007	(0.010)	827,065
Recode Lunda as 0	0.006	(0.010)	827,065
Recode Margi as 0	0.008	(0.010)	827,065
Recode Mijikenda as 0	0.011	(0.010)	827,065
Recode Oron as 0	0.008	(0.010)	827,065
Recode Sierra Leone as 0	0.007	(0.010)	834,145
Recode Tiv as 0	0.007	(0.010)	827,065
Recode Turkana as 0	0.008	(0.010)	827,065
Recode Yao as 0	0.008	(0.011)	827,065
Recode Yoruba as 0	0.014	(0.010)	827,065
Recode all missing as 0	-0.001	(0.010)	1,009,689
Recode Dagara as Missing	0.007	(0.010)	825,325
Recode Wurkum as Missing	0.007	(0.010)	826,414

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Robust standard errors in parentheses. Each row is the equivalent of Column (4) from Table 2 with the stated recoding.

	(1)	(2)	(3)	(4)	(5)	(6)
			Child Mortality			
Twin X TwinKilling	0.004	-0.006	0.011	0.007		
	(0.013)	(0.012)	(0.015)	(0.015)		
Twin	0.189***	0.196***	0.179***	0.185***		
	(0.007)	(0.006)	(0.008)	(0.008)		
TwinKilling	-0.017*	-0.024**	-0.009	-0.009	0.009	-0.012
	(0.009)	(0.010)	(0.008)	(0.006)	(0.014)	(0.013)
Observations	580,788	523,498	239,471	234,568	18,778	17,144
Outcome Mean	0.133	0.132	0.123	0.120	0.253	0.256
Coding	DHS	Murdock	DHS	Murdock	DHS	Murdock
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Specification	Full Sample with Country FE	Full Sample with Country FE	Border Sample with Country FE	Border Sample with Country FE	Twin Sample with Country FE	Twin Sample with Country FE

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by the DHS ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)
	Twin			
Panel A. Twin Killing Coded by DHS Ethnicity				
TwinKilling	0.000	-0.001	-0.000	-0.001
	(0.002)	(0.001)	(0.002)	(0.001)
Observations	827,065	827,065	337,534	337,534
Outcome Mean	0.0329	0.0329	0.0323	0.0323
Panel B. Twin Killing Coded by Murdock Ethnicity				
TwinKilling	0.002	-0.000	0.000	-0.002*
	(0.002)	(0.001)	(0.001)	(0.001)
Observations	759,183	759,183	331,891	331,891
Outcome Mean	0.0332	0.0332	0.0321	0.0321
Sample	Full	Full	Border	Border
Country Fixed Effects	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	No	Yes
Mother Fixed Effects	No	No	No	No
Controls	Yes	Yes	Yes	Yes

Table A8. Twinning as Outcome

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by the DHS ethnicity in Panel A, and Murdock Ethnicity in Panel B. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Infant	Mortality			Child	Mortality	
Central Africa								
Twin X TwinKilling	0.029	0.042**	0.031	0.039*	0.026	0.039*	0.030	0.033
	(0.024)	(0.020)	(0.023)	(0.020)	(0.025)	(0.023)	(0.025)	(0.024)
Observations	122,105	100,018	122,105	100,018	122,105	100,018	122,105	100,018
Outcome Mean	0.0727	0.0745	0.0727	0.0745	0.122	0.123	0.122	0.123
Eastern Africa								
Twin X TwinKilling	0.018	0.003	0.019	0.003	0.015	-0.001	0.015	-0.001
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Observations	267,558	257,560	267,558	257,560	267,558	257,560	267,558	257,560
Outcome Mean	0.0597	0.0603	0.0597	0.0603	0.0909	0.0916	0.0909	0.0916
Southern Africa								
Twin X TwinKilling	0.076	0.020	0.076	0.017	0.013	-0.015	0.014	-0.019
	(0.049)	(0.033)	(0.048)	(0.032)	(0.053)	(0.035)	(0.053)	(0.035)
Observations	11,177	13,504	11,177	13,504	11,177	13,504	11,177	13,504
Outcome Mean	0.0498	0.0467	0.0498	0.0467	0.0683	0.0637	0.0683	0.0637
Western Africa								
Twin X TwinKilling	-0.007	-0.010	-0.007	-0.009	0.008	-0.004	0.010	-0.002
	(0.015)	(0.014)	(0.015)	(0.014)	(0.015)	(0.014)	(0.015)	(0.014)
Observations	426,225	388,101	426,225	388,101	426,225	388,101	426,225	388,101
Outcome Mean	0.0841	0.0834	0.0841	0.0834	0.144	0.142	0.144	0.142
Coding	DHS	Murdock	DHS	Murdock	DHS	Murdock	DHS	Murdock
Sample	Full	Full	Full	Full	Full	Full	Full	Full
Fixed Effects	Country	Country	Region	Region	Country	Country	Region	Region
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		

Table A10. By Pre-Colonial Agricultural Importance

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
Panel A. 0 to 55% Dependence on Agriculture						
Twin X TwinKilling	0.042***	0.044***	0.033**	0.046***	0.049***	0.038***
	(0.013)	(0.013)	(0.015)	(0.012)	(0.012)	(0.013)
Twin	0.158***	0.158***	0.171***	0.166***	0.166***	0.184***
	(0.008)	(0.008)	(0.009)	(0.007)	(0.007)	(0.009)
TwinKilling	0.006	0.002		0.009	0.004	
	(0.004)	(0.004)		(0.007)	(0.007)	
Observations	232,028	232,024	221,238	232,028	232,024	221,238
Outcome Mean	0.0645	0.0645	0.0656	0.105	0.105	0.108
Panel B. 55 to 100% Dependence on Agriculture						
Twin X TwinKilling	-0.018	-0.018	-0.017	-0.012	-0.012	-0.012
	(0.012)	(0.012)	(0.014)	(0.013)	(0.012)	(0.014)
Twin	0.178***	0.180***	0.191***	0.188***	0.191***	0.206***
	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.009)
TwinKilling	-0.012**	-0.002		-0.035**	-0.010**	
	(0.006)	(0.003)		(0.014)	(0.004)	
Observations	540,121	540,121	514,705	540,121	540,121	514,705
Outcome Mean	0.0787	0.0787	0.0802	0.131	0.131	0.135
Coding	DHS	DHS	DHS	DHS	DHS	DHS
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

Table A11. By Access to a Health Facility

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
Panel A. Above Median Health Facility Access						
Twin X TwinKilling	0.007	0.007	0.006	0.015	0.016	0.017
	(0.012)	(0.012)	(0.014)	(0.013)	(0.013)	(0.015)
Twin	0.153***	0.155***	0.169***	0.160***	0.164***	0.178***
	(0.006)	(0.006)	(0.008)	(0.007)	(0.007)	(0.009)
TwinKilling	-0.006	-0.001		-0.019	-0.004	
	(0.005)	(0.002)		(0.012)	(0.003)	
Observations	402,796	402,796	380,709	402,796	402,796	380,709
Outcome Mean	0.0669	0.0669	0.0686	0.109	0.109	0.113
Panel B. Below Median Health Facility Access						
Twin X TwinKilling	0.012	0.012	0.014	0.009	0.012	0.008
	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)
Twin	0.176***	0.177***	0.183***	0.191***	0.193***	0.205***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
TwinKilling	-0.002	0.000		-0.010	-0.004*	
	(0.003)	(0.002)		(0.007)	(0.003)	
Observations	386,997	386,997	371,968	386,997	386,997	371,968
Outcome Mean	0.0766	0.0766	0.0776	0.126	0.126	0.129
Coding	DHS	DHS	DHS	DHS	DHS	DHS
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Child Mortality			Child Mortality		
Panel A. By Polygamy						
Twin X TwinKilling	-0.032	0.015	0.054**	0.004	0.005	0.001
	(0.024)	(0.043)	(0.006)	(0.011)	(0.011)	(0.011)
Observations	10,432	10,432	9,694	746,561	746,559	711,938
Outcome Mean	0.106	0.106	0.111	0.124	0.124	0.127
Sample	Not Polygynous	Not Polygynous	Not Polygynous	Polygynous	Polygynous	Polygynous
Panel B. By Jurisdictional Hierarchy						
Twin X TwinKilling	0.000	0.001	-0.010	0.008	0.010	0.013
	(0.016)	(0.015)	(0.015)	(0.015)	(0.014)	(0.016)
Observations	400,529	400,528	382,308	353,486	353,486	336,584
Outcome Mean	0.128	0.128	0.131	0.119	0.119	0.122
Sample	No Hierarchy	No Hierarchy	No Hierarchy	Hierarchy	Hierarchy	Hierarchy
Panel C. By Patrilineal						
Twin X TwinKilling	0.014	0.018	0.011	0.004	0.003	0.002
	(0.015)	(0.015)	(0.017)	(0.014)	(0.013)	(0.014)
Observations	241,185	241,183	229,185	530,166	530,164	505,997
Outcome Mean	0.109	0.109	0.112	0.130	0.130	0.133
Sample	Not Patrilineal	Not Patrilineal	Not Patrilineal	Patrilineal	Patrilineal	Patrilineal
Panel D. By Female Importance in Agriculture						
Twin X TwinKilling	-0.007	-0.008	-0.015	0.001	0.004	-0.006
	(0.011)	(0.012)	(0.014)	(0.019)	(0.018)	(0.018)
Observations	250,652	250,651	237,245	345,649	345,648	330,637
Outcome Mean	0.0953	0.0953	0.0978	0.140	0.140	0.144
Sample	Equal or Greater	Equal or Greater	Equal or Greater	Less Than Men	Less Than Men	Less Than Men
Coding	DHS	DHS	DHS	DHS	DHS	DHS
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table A12. By Pre-Colonial Institutions

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
Panel A. Above Median Fractionalization						
Twin X TwinKilling	0.010	0.011	0.011	0.016	0.018	0.019
	(0.010)	(0.010)	(0.012)	(0.011)	(0.011)	(0.012)
Twin	0.162***	0.163***	0.177***	0.170***	0.172***	0.188***
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
TwinKilling	-0.000	-0.001		-0.004	-0.004	
	(0.003)	(0.002)		(0.006)	(0.002)	
Observations	394,108	394,108	372,363	394,108	394,108	372,363
Outcome Mean	0.0704	0.0704	0.0718	0.114	0.114	0.117
Panel B. Below Median Fractionalization						
Twin X TwinKilling	-0.005	-0.005	-0.004	-0.001	0.000	-0.003
	(0.016)	(0.015)	(0.016)	(0.015)	(0.015)	(0.015)
Twin	0.181***	0.183***	0.190***	0.190***	0.193***	0.206***
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)
TwinKilling	-0.007	0.004		-0.024*	0.001	
	(0.006)	(0.003)		(0.013)	(0.004)	
Observations	432,957	432,957	416,036	432,957	432,957	416,036
Outcome Mean	0.0774	0.0774	0.0786	0.130	0.130	0.133
Coding	DHS	DHS	DHS	DHS	DHS	DHS
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table A13. By Ethnic Fractionalization

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)
Table A14. By Migration						
		Infant Mortality			Child Mortality	
Panel A. Above Median Migration						
Twin X TwinKilling	-0.011	-0.010	-0.022	0.001	0.002	-0.018
	(0.022)	(0.022)	(0.023)	(0.017)	(0.017)	(0.020)
Twin	0.183***	0.184***	0.198***	0.186***	0.186***	0.209***
	(0.017)	(0.017)	(0.017)	(0.014)	(0.014)	(0.016)
TwinKilling	-0.001	-0.002		-0.006	-0.005*	
	(0.002)	(0.002)		(0.003)	(0.003)	
Observations	177,960	177,960	169,919	177,960	177,960	169,919
Outcome Mean	0.0683	0.0683	0.0694	0.113	0.113	0.116
Panel B. Below Median Migration						
Twin X TwinKilling	0.021	0.020	0.022	0.021	0.019	0.023
	(0.017)	(0.017)	(0.019)	(0.017)	(0.018)	(0.021)
Twin	0.152***	0.153***	0.170***	0.164***	0.165***	0.183***
	(0.007)	(0.007)	(0.009)	(0.006)	(0.006)	(0.009)
TwinKilling	-0.008**	-0.005**		-0.017**	-0.011***	
	(0.004)	(0.002)		(0.007)	(0.003)	
Observations	203,310	203,310	192,564	203,310	203,310	192,564
Outcome Mean	0.0625	0.0625	0.0640	0.0993	0.0993	0.102
Coding	DHS	DHS	DHS	DHS	DHS	DHS
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
Panel A. Above Median Conflict						
Twin X TwinKilling	0.003	0.004	0.009	0.002	0.004	0.016
	(0.013)	(0.013)	(0.015)	(0.014)	(0.014)	(0.016)
Twin	0.169***	0.171***	0.178***	0.177***	0.181***	0.189***
	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
TwinKilling	-0.003	0.002		-0.016	-0.001	
	(0.005)	(0.003)		(0.013)	(0.005)	
Observations	359,077	359,077	342,126	359,077	359,077	342,126
Outcome Mean	0.0779	0.0779	0.0793	0.125	0.125	0.128
Panel B. Below Median Conflict						
Twin X TwinKilling	0.005	0.005	0.001	0.017	0.016	0.003
	(0.012)	(0.012)	(0.013)	(0.013)	(0.012)	(0.013)
Twin	0.172***	0.173***	0.187***	0.181***	0.183***	0.202***
	(0.008)	(0.008)	(0.009)	(0.007)	(0.007)	(0.008)
TwinKilling	-0.003	-0.001		-0.009	-0.005*	
	(0.003)	(0.002)		(0.006)	(0.003)	
Observations	456,947	456,947	435,635	456,947	456,947	435,635
Outcome Mean	0.0710	0.0710	0.0724	0.121	0.121	0.124
Coding	DHS	DHS	DHS	DHS	DHS	DHS
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table A15. By Conflict

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
Twin X TwinKilling	0.002	0.002	-0.005	0.006	0.006	-0.003
	(0.014)	(0.014)	(0.016)	(0.014)	(0.014)	(0.016)
TwinKilling X Both Female	-0.011	-0.009	-0.000	-0.011	-0.009	0.004
	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)	(0.019)
TwinKilling X Mixed	0.010	0.011	0.021	0.013	0.015	0.024
	(0.017)	(0.017)	(0.020)	(0.018)	(0.018)	(0.022)
TwinKilling	-0.004	0.000		-0.014	-0.004	
	(0.004)	(0.002)		(0.010)	(0.002)	
Twin	0.197***	0.198***	0.211***	0.206***	0.208***	0.225***
	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.011)
Both Female	-0.040***	-0.040***	-0.044***	-0.039***	-0.038***	-0.043***
	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)
Mixed	-0.034***	-0.033***	-0.036***	-0.036***	-0.034***	-0.037***
	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.011)
Observations	827,065	827,065	788,399	827,065	827,065	788,399
Coding	DHS	DHS	DHS	DHS	DHS	DHS
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table A16. By Composition of the Twin Pair

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

Table A17. Interaction with Rainfall Shocks

	(1) Infant Mortality	(2) Child Mortality
Rain X Twin X Twin Killing	0.002	0.003
	(0.019)	(0.018)
Rain X Twin Killing	-0.003	-0.005
	(0.003)	(0.004)
Rain X Twin	-0.003	-0.004
	(0.012)	(0.010)
Twin X TwinKilling	0.002	0.007
	(0.026)	(0.025)
Rain	-0.003	-0.010***
	(0.002)	(0.003)
Twin	0.176***	0.188***
	(0.017)	(0.016)
TwinKilling	0.004	0.003
	(0.004)	(0.005)
Observations	811,456	811,456
Mean of Outcome	0.0741	0.123
Coding	DHS	DHS
Fixed Effects	Cluster and Year of Birth	
Controls	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female and birth order.

	Table A18. Investments in Children (Murdock Coding)				
	(1)	(2)	(3)	(4)	(5)
	Received bcg	Received polio 0	Received measles	Number of polio 1 to 3 vaccines received	Number of DPT 1 to 3 vaccines received
Twin X TwinKilling (Murdock)	0.002	-0.002	-0.008	-0.044	-0.002
	(0.000)	(0.000)	(0.018)	(0.050)	(0.055)
Controls + Country FE	Yes	Yes	Yes	Yes	Yes
Observations	163,943	164,061	163,236	163,184	163,132
Mean of Dependent Variable	0.830	0.672	0.614	2.206	2.135
	(6)	(7)	(8)	(9)	(10)
	Number of vaccines received	Months of breastfeeding	Below Median months of Breastfeeding	Place of delivery: home	Assistance: doctor
Twin X TwinKilling (Murdock)	-0.056	0.284	-0.015	0.007	0.027*
	(0.109)	(0.566)	(0.025)	(0.000)	(0.015)
Controls + Country FE	Yes	Yes	Yes	Yes	Yes
Observations	161,500	95,208	95,208	197,813	199,139
Mean of Dependent Variable	4.965	11.54	0.508	0.379	0.0874
	(11)	(12)	(13)	(14)	(15)
	Weight/Height percentile	Weight/Age percentile	Height/Age percentile	Birth weight in kilograms (3 decimals)	Size of child at birth
Twin X TwinKilling (Murdock)	293.975**	153.160	115.133	2.902	-0.055
	(116.181)	(130.849)	(162.073)	(54.233)	(0.046)
Controls + Country FE	Yes	Yes	Yes	Yes	Yes
Observations	118,682	117,709	117,709	99,524	187,548
Mean of Dependent Variable	3806	2441	2516	3204	2.735

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by the Murdock ethnicity. Controls are female, birth order, and year of birth.

Table A19. Results for subsamples distant from missions

	(1)	(2)	(3)	(4)	(5)	(6)
			Child Mortality			
Panel A: Above-median distance from mission						
Twin X TwinKilling	0.036**	0.036**	0.037**	0.025*	0.023*	0.025
	(0.016)	(0.016)	(0.019)	(0.014)	(0.014)	(0.016)
Observations	148,626	148,626	142,608	347,727	347,727	333,762
Mean of Dependent Variable	0.138	0.138	0.140	0.144	0.144	0.147
Panel B: Above-median distance from Protestant mission						
Twin X TwinKilling	0.031*	0.031*	0.028	0.026*	0.024*	0.027*
	(0.016)	(0.016)	(0.019)	(0.014)	(0.014)	(0.016)
Observations	151,473	151,473	145,295	349,857	349,857	335,734
Mean of Dependent Variable	0.138	0.138	0.141	0.143	0.143	0.146
Panel C: Protestant mission > 25 km						
Twin X TwinKilling	0.024*	0.024*	0.021	0.007	0.009	0.011
	(0.013)	(0.013)	(0.014)	(0.012)	(0.011)	(0.012)
Observations	251,598	251,598	241,098	562,581	562,581	538,865
Mean of Dependent Variable	0.124	0.124	0.126	0.131	0.131	0.134
Coding	DHS	DHS	DHS	Murdock	Murdock	Murdock
Sample	Border	Border	Border	Full	Full	Full
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Region Fixed Effects	No	Yes	Yes	No	Yes	Yes
Mother Fixed Effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by DHS ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
British Africa						
Twin X TwinKilling	-0.002	-0.003	-0.002	0.005	0.004	0.010
	(0.015)	(0.015)	(0.016)	(0.015)	(0.015)	(0.016)
Observations	159,809	159,809	152,039	159,809	159,809	152,039
Outcome Mean	0.0625	0.0625	0.0637	0.0992	0.0992	0.102
French Africa						
Twin X TwinKilling	0.011	0.011	0.010	0.028*	0.030*	0.025
	(0.015)	(0.015)	(0.018)	(0.015)	(0.015)	(0.018)
Observations	161,793	161,793	154,780	161,793	161,793	154,780
Outcome Mean	0.0743	0.0743	0.0753	0.129	0.129	0.132
Other (Ethiopia, Liberia, Mozambique and Namibia) Africa						
Twin X TwinKilling	0.040	0.046	0.077*	0.009	0.020	0.040
	(0.046)	(0.044)	(0.040)	(0.042)	(0.042)	(0.061)
Observations	15,932	15,932	14,822	15,932	15,932	14,822
Outcome Mean	0.0727	0.0727	0.0751	0.103	0.103	0.107
Fixed Effects	Country	Region	Mother	Country	Region	Mother
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table A20. Border sample results by colonizer

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)
	Infant Mortality		Child Mortality	
British Africa				
TwinKilling	-0.025	-0.010	-0.047*	-0.008
	(0.017)	(0.015)	(0.025)	(0.016)
Observations	12,438	12,438	12,438	12,438
Outcome Mean	0.232	0.232	0.286	0.286
French Africa				
TwinKilling	0.048***	0.034*	0.069***	0.051***
	(0.016)	(0.019)	(0.016)	(0.017)
Observations	12,374	12,374	12,374	12,374
Outcome Mean	0.241	0.241	0.305	0.305
Other (Ethiopia, Liberia, Mozambique and Namibia) Africa				
TwinKilling	0.073***	0.070*	0.027	0.045
	(0.022)	(0.037)	(0.027)	(0.028)
Observations	2,374	2,374	2,374	2,374
Outcome Mean	0.282	0.282	0.334	0.334
Fixed Effects	Country	Region	Country	Region
Controls	Yes	Yes	Yes	Yes

Table A21. Twin sample results by colonizer

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by ethnicity. Controls are female, birth order, and year of birth.

	(1)	(2)	(3)	(4)
	Infant Mortality		Child Mortality	
British Africa				
TwinKilling	-0.011	-0.021	-0.020	-0.009
	(0.021)	(0.019)	(0.027)	(0.018)
Observations	4,918	4,918	4,918	4,918
Outcome Mean	0.206	0.206	0.255	0.255
French Africa				
TwinKilling	0.034**	0.021	0.054***	0.044**
	(0.016)	(0.017)	(0.018)	(0.017)
Observations	5,634	5,634	5,634	5,634
Outcome Mean	0.242	0.242	0.311	0.311
Other (Ethiopia, Liberia, Mozambique and Namibia) Africa				
TwinKilling	0.030	0.045	0.018	0.034
	(0.052)	(0.053)	(0.046)	(0.061)
Observations	364	364	364	364
Outcome Mean	0.255	0.255	0.308	0.308
Fixed Effects	Country	Region	Country	Region
Controls	Yes	Yes	Yes	Yes

Table A22. Twin and border sample results by colonizer

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by ethnicity. Controls are female, birth order, and year of birth.

Table A23. Murdock coding by colonizer

	(1)	(2)	(3)	(4)	(5)	(6)
	Infant Mortality			Child Mortality		
British Africa						
Twin X TwinKilling	-0.025**	-0.024*	-0.020	-0.027**	-0.023*	-0.017
	(0.012)	(0.012)	(0.014)	(0.012)	(0.012)	(0.013)
Observations	356,269	356,269	339,294	356,269	356,269	339,294
Outcome Mean	0.0713	0.0713	0.0727	0.114	0.114	0.118
French Africa						
Twin X TwinKilling	0.037***	0.036***	0.028*	0.044***	0.041**	0.030
	(0.012)	(0.012)	(0.015)	(0.016)	(0.016)	(0.019)
Observations	328,508	328,508	313,511	328,508	328,508	313,511
Outcome Mean	0.0757	0.0757	0.0770	0.130	0.130	0.134
Other (Liberia, Mozambique and Namibia) Africa						
Twin X TwinKilling	-0.015	-0.015	-0.001	-0.019	-0.019	0.012
	(0.023)	(0.023)	(0.025)	(0.028)	(0.026)	(0.026)
Observations	74,406	74,406	69,846	74,406	74,406	69,846
Outcome Mean	0.0767	0.0767	0.0787	0.112	0.112	0.115
Fixed Effects	Country	Region	Mother	Country	Region	Mother
Controls	Yes	Yes	Yes	Yes	Yes	Yes

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Standard errors in parentheses clustered by ethnicity. Controls are female, birth order, and year of birth.