Demand for Vaccination in Sub-Saharan Africa: The Vertical Legacy of the Slave Trade

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Abstract

We combine historical data on the slave trade by ethnic group with individual-level data geolocated at the cluster level from the 2010-2014 Demographic and Health Surveys to examine the relationship between ancestors' exposure to the slave trade and children vaccination status against measles. Exploiting within-location variation, and hence isolating the vertical cultural transmission channel of the slave trade, we find that children from mothers whose ancestors were exposed to the slave trade are less likely to be vaccinated than children living in the same location but with mothers from a slave-free ethnic group. The effect is larger than that of standard determinants of health demand, such as education or revenue, and is not confined to parents health decisions for their children. We find evidence of increased adverse effect of slave trade exposure on contemporaneous demand for vaccination among the descendants whose family has a higher preference for traditional practices and higher incentives to transmit their inherited cultural traits. While we know that there is not a uniform health policy code deemed appropriate for all geographical areas, our results suggest that there is space to integrate ethnic groups'

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historical-specificity in health policy design and communication.

Keywords: Vaccine, Health demand, Trust, Slave trade, Vertical Cultural transmission

1 Introduction

Despite improvements in health technology and access, immunization rates in sub-Saharan Africa remain very low. While we can observe significant differences across countries, none of them reaches the herd immunity level that guarantees the protection of the entire population against the spread of highly infectious diseases such as measles (World Health Organization (2018)). The standard explanation given by the extant literature is imperfect information on illness prevention due to both low penetration of public health communication media and low education levels (Dupas (2011)). However, we know that in environments where information acquisition is costly and/or imperfect, individuals use "rules-of-thumb", that is, cognitive short-cuts, to make their decisions (Boyd and Richerson (1985), Brownlie and Howson (2005)). The view that trust should be considered as an important determinant of vaccination decision has been now extensively motivated, encompassing not only trust in vaccines effectiveness but also institutional trust (i.e. trust in the health system and trust in public authorities that decide on the required vaccines) (Gilson (2003), Thiede (2005), Yaqub et al. (2014), MacDonald (2015), Larson (2016), Larson et al. (2018), Jamison et al. (2019)).

In their theoretical framework, Bisin and Verdier (2001) model current trust levels as being shaped by both the contemporaneous environment (socialization outside the family, also called horizontal socialization) and the cultural traditions inherited from earlier generations (socialization inside the family, also called vertical socialization). Streefland et al. (1999), echoing a rich literature in pharmaceutical anthropology (see Etkin and Tan (1994)), document that "local vaccination cultures with their own health practices, knowledge and beliefs about immunization and past experiences with routine or campaign vaccination" largely determine whether parents continue to have their children vaccinated. Lowes and Montero (2021) find that a region's greater exposure to colonial medical campaigns between 1921 and 1956 in Central Africa reduces present-day completed vaccinations for children residing in those regions, and that health interventions are less successful in areas with greater exposure to the campaigns. In the same vein, Alsan and Wanamaker (2018), using geographic distance to Macon County, Alabama,

which contains Tuskegee, as an exposure to treatment, show that the disclosure of the Tuskegee study was associated with a decline in utilization of medical services and with negative health outcomes for black males living in states close to Tuskegee. As underlined by the authors, this suggests that "individuals in closer geographic proximity believe the event is more instructive for how they may anticipate being treated by their local medical system". At the same time, qualitative studies mostly rely on well-defined geographic populations to understand vaccination decisions (e.g. Attwell et al. (2018), Helps et al. (2019)).

However, much less is known about the persistence of vertical transmission of values and beliefs for vaccine acceptance within a given local cultural context. In particular, Jamison et al. (2019) explore narratives from White and African American adults describing their institutional trust, with a focus on influenza vaccine. They find racial differences related specifically to trust in government that are commonly explained by the role of history. They mention this particular quote from an African American male: "Well, African American folks, they don't really trust as much as White–you know, as White Americans trust, because you know due to this history of slavery and the whole nine yards, they just a little bit – they doubt a little bit".[1] Interestingly, Jamison et al. (2019) also find that "in these discussions, African Americans were more likely to describe the history in general terms without detailing personal encounters."[2] This evidence cries out for the consideration of the slave trade to explain vaccination decisions through the vertical transmission of specific cultural traits inherited from earlier generations.

In this paper, we investigate the impact of the slave trade on present-day vaccination rates in sub-Saharan Africa exploiting variation in slave trade exposure across ethnic groups within small localities. More specifically, we use data from the Demographic and Health Surveys (DHS) female module, collected in the period 2010-2014, that provide in-

[1]This qualitative evidence is in line with Nunn and Wantchekon (2011)'s quantitative results that point to a negative causal impact of the slave trade on current interpersonal trust, namely trust in relatives, neighbours, co-ethnics, and locally elected people.

[2]Nunn and Wantchekon (2011) also uncover that most of the impact of the slave trade channels through internal factors to the individual, such as cultural norms and beliefs, rather than through external factors, such as institutions.

formation on mothers' children (under five years) vaccination status against measles. The immunization data are then combined with historical data from Nunn and Wantchekon (2011) on the slave trade by ethnic group to estimate the relationship linking contemporaneous children vaccination status against measles to ancestors' exposure to the slave trade. Importantly, the DHS survey respondents are geolocated at the cluster level, which corresponds to the primary sampling unit (small geographic areas, often villages in rural areas and city blocks in urban areas). In order to identify the role played by the vertical mechanism of cultural persistence, we adopt a within-cluster estimation strategy, hence comparing only vaccination status of children currently living in the same location. In other words, we isolate the impact of a child's ethnic origin while keeping constant the current local environment. Thus, we control for any impact of the slave trade on the characteristics of the respondent's location, that is, on local vaccination cultures. This strategy implies that the source of identification is the movers in the sample, that is, individuals of different ethnic groups who have relocated over the centuries from their ancestors' original ethnic homeland and who bring variation in exposure to the slave trade across ethnic groups living in the same cluster.

However, there may be ethnicity historical events or pre-colonial cultural norms that are correlated with selection into the slave trade and subsequent demand for vaccination. In particular, we could expect that ethnic groups that were culturally more inclined to adopt preventative measures in general were less likely to be enrolled in the slave trade, and continue to be more in favor of preventative medicine today. To rule out this possibility, we control for ethnic group initial cultural preferences for preventative behavior, using data on pre-colonial ethnic group norms from Murdock's (1967) Ethnographic Atlas database. We further include indicators on the type of ethnic groups pre-colonial political succession, whether hereditary or not, to capture parents incentives to invest in children health. We also use data from Michalopoulos and Papaioannou (2016) to include controls for colonial intervention characteristics at the ethnic group level that resulted in potential health and political ethnic distance.

Our findings indicate a significant adverse effect of ancestors' exposure to the slave

trade on descendants demand for vaccination. More specifically, a child with a mother belonging to a slave-raided ethnic group is 5 percentage points less likely to be vaccinated against measles than a child living in the same location with a mother from a slave-free ethnic group. This effect offsets or even dominates the effect of standard determinants of health demand, such as income and education. Implementing a counterfactual analysis, this estimate predicts a 25% increase in the coverage rate for the ethnic group with the lowest immunization rate in the sample had they been a slave free group, leading to a 50% drop in measles incidence rate.

As robustness checks, we exploit demand for other healthcare services to show that the effect of the slave trade is not confined to parents vaccine decisions for their children, which may be substantially different from their own health utilization decisions, but instead affects global pattern of health demand, even for non-core health services (free blood-test consent) or for less relational services (the use of malaria insecticide-treated nets (ITNs)).

We further investigate the role played by cultural transmission mechanisms within the family. Bisin and Verdier (2001) theorize that if parents, while altruistic, tend to prefer children with their own cultural traits, then both parents' preferences and value of their children welfare are likely to explain intergenerational transmission of cultural values. We find evidence of increased adverse effect of slave trade exposure on contemporaneous demand for vaccination among the descendants whose family has a higher preference for traditional practices and higher incentives to transmit their inherited cultural traits.

This paper contributes to three main streams of research. First, our work emphasize the role and importance of vertical mechanisms of cultural persistence in explaining variation in demand for vaccination and for health in general, as individuals belonging to different ethnicities but living today in the same location have a probability of accepting health services that depend on whether their ancestors were affected by the slave trade. Importantly, we show that the effect of vertical transmission of mistrust persists in the very long run, even in potentially positive local vaccination cultures. Thus, while the literature illuminates mostly the variation and dynamic nature of vaccination trajectories (Yaqub et al. (2014), Wiley et al. (2020)), this paper suggests that vaccination decisions

imply also an important static trait.

Second, our work contributes to studies documenting the long-term effect of the slave trade. We know that the slave trade affected economic development (e.g. Nunn (2008)), trust (e.g. Nunn and Wantchekon (2011)), gender norms and female labour force participation (Teso (2018)), the prevalence of polygyny (e.g. Dalton and Leung (2014)), and consequently on HIV rates (Bertocchi and Dimico (2019)). This paper shows that this historical event also played an essential role in shaping health behaviors and resulting health outcomes across the continent.

Third, our work also speaks to the cultural transmission literature. While there is an extensive theoretical literature in several social sciences about cultural transmission (e.g. Rogers (1988), Bisin and Verdier (2001, 2011), Boyd and Richerson (2005)), empirical analysis of cultural transmission models are scarce. In this paper, we identify specific cultural transmission mechanisms inside the family, related to parents' preferences and incentives, to explain the dynamics of cultural attitudes. This could shed light on the heterogeneity of economic outcomes associated with some cultural traits.

The outline of the paper is as follows. Section 2 describes the data and the main empirical specification. The empirical results on the relationship between the slave trade and present-day children vaccination status against measles, together with robustness checks and the analysis of the vertical cultural transmission mechanisms within the family, are presented in Section 3. Section 4 concludes and discusses implications for present-day health policy in sub-Saharan Africa.

2 Data and Empirical Specification

In this section, we present the variables used in the analysis. The details about the exact variables description, summary statistics, and sources of all data are presented in Table IV and in Table V in the Appendix, Section A.1.

2.1 Historical Slave Trade Data

The historical data on slave exports by ethnic group comes from Nunn (2008). The author combined data from various historical records that report the ethnic identities of slaves exported from Africa with data on the number of slaves shipped from each African port or region during the transatlantic and the Indian Ocean slave trades. The primary data sources for slaves exports are from the Transatlantic Slave Trade Database constructed by Eltis et al. (1999) and from Austen (1979, 1988, 1992) for the Indian Ocean trades. Nunn (2008) could then match a total of 80,656 slaves to 229 identified ethnic groups for the transatlantic slave trade and 21,048 slaves to 80 distinct ethnic groups for the Indian Ocean slave trade. In a final step, Nunn and Wantchekon (2011) match the ethnic identity recorded in the slave trade databases to the ethnic identity reported by respondents of the Afrobarometer surveys, based on the historical classification by Murdock (1959).

We follow the same procedure for the ethnic designation reported by the respondents in the DHS survey that we match when necessary to Murdock (1959) classification, allowing a simple merge to Nunn and Wantchekon (2011) ethnic groups slave exporting data. The matching goes from relatively simple correspondence (e.g., in the case of Uganda, BaGanda or BaSoga ethnic group from DHS corresponds to GANDA and SOGA in the Murdock classification) to slightly less straightforward correspondence (e.g., in the case of Senegal, where PULAAR ethnic group in the DHS is related to FUTATORO in Murdock ancient classification).

In our study, we end up with a final sample of 98 ethnic groups with 68 (69%) groups recorded as exporting slaves and 30 as slave-free. Each ethnic group represents a minimal share of 5% of its country population.

2.2 Contemporaneous Vaccination Data

We combine the historical data on slave exports with DHS data from the most recent compatible surveys (collected between 2010 and 2014, except for Central Africa, Niger and Ethiopia collected respectively in 1994, 1998 and 2003), and in particular the female modules questionnaires containing information on the immunization status of their chil-

dren born in the last 5 years. We restrict our interest to countries where geolocated survey data exist and where the respondent's ethnic group identity is reported.

The baseline sample in our study consists of 157,405 children born to 101,866 adult mothers from 98 ethnic groups with a minimal size of 5% of each country population, covering 18 sub-Saharan African countries.

We focus on a particular infectious and vaccine-preventable disease that is measles, which remains one of the world-leading cause of children under-five mortality and morbidity. Even when it does not lead to death, child infections might result in lifelong disability such as blindness, deathless, or severe respiratory infections, undermining the child's future education and economic prospect. In 2015, there were 134,200 measles deaths in the world, which amounts to about 367 deaths every day or 15 deaths every hour, with developing countries concentrating more than 95% of these deaths (World Health Organization 2018). In sub-Saharan Africa, despite the vaccine effectiveness and free provision by public health facilities, measles was the lowest-performing vaccine in terms of coverage rate in 2016, with an average country coverage of 75% in 2016, and with no countries reaching the 95% herd immunity level. In addition, by focusing on a traditionally one-shot vaccine, we avoid the complexity and sequentiality involved in other vaccines requiring multiple shots and hence, more active computation, memory, and reasoning.

Table VI in the Appendix Section A.1 presents summary statistics for the main variables in the analysis at the geographical cluster level. The sample of interest includes 9726 clusters (primary localities) from the 18 sub-Saharan African countries. In our sample, there are an average of 16 children and 1.70 different ethnic groups within each location. More than 25% of the locations have more than two ethnic groups, reaching a maximum of 7 different ethnic groups in some clusters. The average measles vaccination rate within each location is 66% with a standard deviation of 25 percentage points. The share of children from slave raided ethnic groups within each location is 80% with a standard deviation of 0.37.

2.3 Contemporaneous and Historical Controls

2.3.1 Child, Mother and Household Controls

The DHS also provides a rich set of questions we build upon to control for the child-specific characteristics that might influence mother's vaccination decisions, such as the gender, the child's birth-order, and an indicator for whether the child was delivered at home or within a health facility.

We also have information about mother's education, literacy status, employment status, religion, and age. We further include variables capturing mother's level of information related to public health issues, using answers to the questions of whether she watches TV or listens to radio. We add a variable capturing the subjective assessment of access to health facility using the mother answer to the question of whether distance to the health facility was a problem or not. As mother's fertility preferences have been shown to affect the investment in child health and protection, we include the mother's total births as well as mother's number of births during the last five years to control for close pregnancies. Importantly, we also include the mother's report of the ideal number of children and of unwanted last birth as proxies for her adoption of contraceptives and hence her preferences regarding the use of preventative health techniques in general. By introducing such controls, we expect to take into account mothers' specific characteristics associated with child investment and with preferences for adopting preventative health behavior and technology.

We also take into account the household's socio-demographic characteristics, capturing intra-household resources allocation and bargaining dimensions. In particular, we control for father employment status, the household wealth index, the gender of the household head and the gender of the head for health decisions.

2.3.2 Pre-colonial Cultural Norms of Preventative Behavior and Child Investment Controls

As there may be historical events, cultural and social norms that are correlated with selection into the slave trade and subsequent vaccination decisions, it is important to

introduce important controls at the ethnic group level. In particular, we could expect that ethnic groups that were culturally more inclined to adopt preventative measures in general, and for children in particular, were less likely to be enrolled in the slave trade, and continue to be more in favor of preventative medicine today. To rule out this possibility, we control for ethnic group initial cultural norms of preventative behavior, using data on pre-colonial ethnic group norms from Murdock (1959) and Murdock's (1967) Ethnographic Atlas database.

More specifically, in the African context, data on sexual norms, in particular on girls premarital sexual behavior norms as well as on post-partum sexual norms, allow to control for initial propensity to adopt preventative behavior. The former captures the insistence on early female marriage or on virginity to prevent early pregnancy outside marriage (by contrast to norms of promiscuous and freely permitted sexual behavior). The latter captures the insistence on absence of post-partum sexual activity to prevent repeated parturitions.

We further include indicators on the type of prevailing political succession, whether hereditary or not. The rationale of this proxy is to capture parents incentives to invest in their children health, knowing that hereditary lineage makes children be perceived as future source of old-age insurance, labor and land income, and source of political power. We also consider ethnic groups pre-colonial political centralization to capture ethnic groups' attitudes towards public authorities.

2.3.3 Colonial Controls for Ethnic Distance

We use data from Michalopoulos and Papaioannou (2016) to include dummies for colonial intervention characteristics resulted in ethnic groups split across country borders as well as in current minority or majority status in contemporaneous national borders. Split ethnic groups have been shown to be more prone to conflicts and to have lower national identity. Thus, including this variable allows us to control for potential identity distance. In addition, including minority status allows to control for potential ethnic distance between mothers' group and the one of the health workers or officers in charge of immunization,

that might lead to ethnic grievance or discrimination during health seeking interactions. It allows also to control for the ethnic distance between mother's ethnic group and the ethnic group mainly represented by the local or central political power.

2.4 Empirical Specification

Our goal is to estimate the relationship linking contemporary demand for vaccination to ancestors' exposure to the slave trade within locations. Thus, we estimate the following equation:

$$Vaccin_{i,m,e,l,c} = \alpha_{lt} + \beta\ Slave_e + \mathbf{X'_{i,m,e,l,c}}\ \boldsymbol{\Gamma} + \mathbf{X'_{m,e,l,c}}\ \boldsymbol{\Omega} + \mathbf{X'_{e}}\ \boldsymbol{\Phi} + \epsilon_{i,m,e,l,c} \quad (1)$$

where $Vaccin_{i,m,e,l,c,t}$ is a binary indicator variable equal to one if child i born to mother m from ethnic group e within locality l and country c is vaccinated against measles, and zero otherwise. α_{lt} denotes a vector of location-(survey) year interacted fixed effects. $Slave_e$ is a binary indicator variable equal to one if the mother's ethnic group e has been slave-raided, and zero otherwise. $\mathbf{X'}_{i,m,e,l,c}$ is the set of child individual controls, while $\mathbf{X'}_{m,e,l,c}$ is the set of mother/household controls. $\mathbf{X'}_{e}$ includes the ethnic-group level controls for pre-colonial cultural preferences for preventative behavior and child investment, and for colonial characteristics associated with ethnic distance. The standard errors are clustered at the ethnic group level. We estimate a linear probability model for ease of interpretation of the results.[3]

[3]The results using a logit regression were similar.

3 The Vertical Legacy of the Slave Trade on Present-Day Demand for Vaccination

3.1 Main Results

Results are reported in Table I. The estimates in Column 2 reflect our baseline estimation, including cluster-year fixed effects. As a comparison, the estimates in Column 1 only reflect within-country-year variations and are adjusted for individual, mother, location[4], and ethnicity-level main characteristics, with standard errors clustered both at the ethnic group level, and at the ethnic group and cluster levels.

When compared to the results in Column 1, the coefficient on the slave trade variable falls by about 50% but remains statistically significant and of important size. Among children currently living in the same location, a child's ancestors' exposure to the slave trade decreases his likelihood of being vaccinated against measles by 5 percentage points. Thus, the estimates suggest that at least half of the effect of the slave trade on demand for vaccination is driven by cultural transmission of mistrust across generations.

To assess the magnitude of the slave export coefficient, we compare its explanatory power against standard determinants of children vaccination (see Table VII in the Appendix Section A.2). We find that the adverse effect of the slave trade is as important as the positive effect of belonging to the highest quantile of the income distribution, as important as the positive effect of having an employed mother, and dominates the positive effect of having a literate mother. Implementing a counterfactual analysis, the estimate predicts a 25% increase (from 20 to 25%) in coverage rate for Hausa in Northern Nigeria — the ethnic group with the lowest immunization rate in our sample — had they been a slave-free ethnic group, leading to 50% drop in measles incidence rate, that is, 10,625

[4]We introduce a rich set of controls for the locality current economic development (density, luminosity at night), the geography (elevation, distance to water, to the sea, and to capital city), the existence of natural resources (diamond mines, petroleum plants). We also include controls for the recent experience of conflicts, violence and riots from Armed Conflict Location and Event Data Project, as well as controls for the district disease environment using the malaria stability index constructed by Kiszewski et al. (2004). These controls are retrieved from Michalopoulos and Papaioannou (2016) and are spatially matched to our DHS sample localities.

cases of infection avoided over two years between 2011 and 2014 [5].

[Table I about here.]

The within-location estimation strategy implies that the source of identification is the movers in the sample (i.e. individuals of different ethnic groups who have relocated over the centuries from their ancestors' original ethnic homeland), who bring variation in exposure to the slave trade across ethnic groups living in the same geographical cluster (location). While we can expect that movers may not be representative of the population, we build on Casari et al. (2018) to assume that if our estimates are biased, they are downward biased. In particular, Casari et al. (2018) provide empirical evidence and a theoretical explanation for self-selection into migration by more trusting individuals according to the origin and destination characteristics. They find that more trusting individuals are more likely to emigrate when the local fraction of trusting peers is low and the destination characteristics make migration more attractive for the trusting. In our sample, 71% of the movers are from slave-raided ethnic groups, implying that their original ethnic homeland is a slave-raided area. We know that slave-trade exposure is associated with more suspicious, less trusting, behaviors. We can then infer that the local fraction of trusting peers in their place of origin is low for these slave-raided movers and that they relocate in slave-free locations characterized by better enforcement of civic behavior. This converges towards the selection of more trusting individuals in our within-location estimation strategy, potentially leading to a downward bias of our estimates for the impact of the slave trade.

Regarding the impact of the other regressors, as expected, we find that initial cultural preferences for preventative behavior and child investments (captured respectively by sexual norms and child heredity variable) have a positive and significant effect on current demand for vaccination (see Table VII in the Appendix Section A.2). Interestingly, the size of the effect is constant across the three variables. Identity and ethnic distances, captured by the minority and split ethnic group variables, do not seem to have a significant

[5]Hall and Jolley (2011) predict that a 1% increase in the MCV1 coverage rate is associated with a 2% decrease in the disease incidence in the same year and the following year.

impact on demand for vaccination. Ethnic groups pre-colonial political centralization is negatively associated with vaccines uptake.

3.2 The Use of Malaria Insecticide-Treated Nets and Blood-Test Consent as Robustness Checks

We investigated so far the impact of the slave trade on parents measles vaccine decisions for their children, which may be substantially different from their own health utilization decisions. To test whether the adverse long-run persistent effect of the slave trade is specific to children vaccination, we use the DHS female modules surveys that also provide information on mothers' consent to a blood test and on their use of malaria insecticide-treated nets (ITNs). These health demand outcomes are of particular interest to the extent that they concern a non-core health service (free blood test) and an important health product (ITNs have been shown to reduce the incidence of malaria by 50% and mortality by 20% (Morel et al. (2005))) but less dependent on the contribution of other people.

Results are reported in Table II. The first column reports the estimate of the relationship between mothers' ancestors exposure to the slave trade and their use of ITN today. Column 2 reports the same estimate with the blood test consent as outcome variable. We demonstrate similarly signed estimates and a statistically significant estimate associated with the blood-test consent outcome variable. These results suggest then that the slave trade has affected global pattern of health demand.

[Table II about here.]

3.3 Cultural Transmission Mechanisms Inside the Family

The previous section has established a robust within-location relationship between the slave trade and contemporaneous demand for children vaccination or for other health services, highlighting the importance and persistence of the vertical cultural transmission

channel in health decisions. We further investigate the role played by cultural transmission mechanisms within the family.

In the economic literature, cultural transmission is formalized as the result of decisions made inside the family (corresponding to the vertical channel of cultural transmission, from parents to children) (Bisin and Verdier (2001)). A fundamental assumption in these models, called "imperfect empathy", implies that parents, while altruistic, tend to prefer children with their own cultural traits. Therefore, as the intergenerational transmission of cultural traits involves economic decisions of rational agents (the cultural parents), an important implication of these models is that the transmission mechanism is not necessarily monotonically increasing in the exogenous material payoffs associated to cultural traits. Thus, according to Bisin and Verdier's (2001) theoretical model, both parents' preferences and value of their children welfare are likely to explain intergenerational transmission of cultural values. Consequently, we expect children from historically slave-raided ethnic groups and whose family has a higher preference for traditional practices (and hence potentially against vaccines) or higher incentives to transmit across generations their inherited cultural traits (mistrust in this specific case), to be even less likely vaccinated.

In particular, among our mother-level variables, religious affiliation, and more specifically, affiliation to traditional African pre-colonial religions (after centuries of monotheist religions (Islam and Christianity) spread across Africa) might capture higher preferences for traditional practices and hence traditional medicine, which could reinforce the effect of mistrust due to slave trade exposure on demand for vaccination. Table III, Panel A, shows the heterogeneous impact of past exposure to the slave trade across religious affiliations. When our main explanatory variable is interacted with the dummy variable traditional religion (column (1)), we find that the negative effect of slave trade exposure more than doubles. By contrast, when our main explanatory variable is interacted with the other religious affiliation dummy variables, we find that the coefficient of the interaction term is not significantly different from 0.

Cultural transmission of mistrust due to past exposure to the slave trade is also expected to be more important when children are more important for parents. Therefore,

we interact our main explanatory variable with the ethnicity-level dummy variable with respect to pre-colonial type of political succession, whether hereditary or not (Table III, Panel B, column (1)). The coefficient of the interaction term is negative but insignificant.

We further investigate whether the type of hereditary succession – matrilineal or patrilineal – plays a role in cultural transmission. As a matter of fact, in matrilineal lineage systems, by definition, women are key for determining descent. This implies that in these systems children represent part of women's outside option, as their kin group has an interest in the children.[6] As a consequence, women not only value more their children's welfare in matrilineal lineage systems[7] but also have higher incentives to transmit to their children their own cultural traits relative to patrilineal systems. Thus, we expect higher persistence in the long-run of inherited cultural mistrust within matrilineal systems, leading to an increased adverse effect of slave trade exposure for children with mothers belonging to matrilineal systems relative to patrilineal lineage systems. The results in Panel B, column (2) show that when our main explanatory variable is interacted with the dummy variable matrilineal lineage, we find that the negative effect of slave trade exposure is multiplied by four. This result could help explain the anthropologists' puzzle (e.g. Douglas (1969)) regarding the stability of matrilineal systems through the transmission of positive views about matrilineal systems to children, including sons.

[Table III about here.]

4 Conclusion

This paper emphasizes the importance played by the transmission of cultural mistrust across generations in explaining variation in children vaccination, as children belonging

[6]This is the reason why a large literature in anthropology assumes that matrilineal systems reduce spousal cooperation (e.g. Radcliffe-Brown (1950)), which has been empirically corroborated by Lowes (2020).

[7]In line with this theory, we find that matrilineal systems lead to better children health outcomes: the coefficient of matrilineal dummy itself is positive and highly significant. More specifically, a child born from a mother belonging to a matrilineal ethnic group is 18 percentage points more likely to be vaccinated against measles than a child whose mother is from a patrilineal ethnic group. Lowes (2020) find similar positive effects of matrilineal systems related to other children health outcomes.

to different ethnicities but living today in the same location have a probability of being vaccinated that depend on whether their ancestors were affected by the slave trade. This effect is larger than that of standard determinants of health demand, such as education or revenue, and also adversely affects parents' own health utilization decisions, even for non-core services such as a blood tests.

The analysis of the vertical cultural transmission mechanisms within the family points to a higher persistence of cultural mistrust inherited from the slave trade in matrilineal systems. We also find that mother's affiliation to traditional religion reinforces the adverse effect of historical exposure to the slave trade.

These results add on complexity for present-day health policies in sub-Saharan Africa. While the focus so far has been on developing health policies that account for local vaccination cultures and contexts, our results show that within a given locality, individuals might behave very differently according to their ethnicity historicity. More precisely, the effect of vertical transmission of cultural traits persists in the very long run, even in potentially positive local vaccination cultures. While we know that there is not a uniform health policy code deemed appropriate for all geographical areas, our results suggest that there is space to integrate ethnic groups' historical-specificity in health policy design and communication.

A Appendices

A.1 Data Description

[Table IV about here.]

[Table V about here.]

[Table VI about here.]

A.2 Complementary Results

[Table VII about here.]

[Table VIII about here.]

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Table I: LPM Estimates of the Determinants of Measles Vaccination

	Measles Vaccine	
	(1)	(2)
Group exports slaves (=1)	-0.0902***	-0.0457**
	(0.0251)	(0.0206)
	[0.0250]	
Child controls	Yes	Yes
Mother controls	Yes	Yes
Household controls	Yes	Yes
Ethnic pre-colonial controls	Yes	Yes
Ethnic colonial controls	Yes	Yes
Location controls	Yes	No
Country x Survey-Year FE	Yes	No
Location x Survey-Year FE	No	Yes
Adj. R-Squared	0.154	0.210
N observations	80088	81280
Number of ethnic groups	98	64
Number of area clusters	9726	7325

The table reports LPM estimates. Below the coefficients, two standard errors are reported: in parentheses are standard errors adjusted for clustering within ethnic groups, in square brackets are standard errors adjusted for two-way clustering within ethnic groups and locations. Child controls include: sex of the child, the order of birth, a dummy for home delivery. Mother controls: education, literacy status, employment status, religion, age, access to health facility, total children, birth interval, ideal number of children, unwanted births, watch TV, listen to radio. Household controls: father employment status, the gender of the houshold head, the household wealth index, mother makes health decision. Ethnic pre-colonial controls include dummies for norms of: child heredity, postpartum sex taboo, rigidity of girls premarital sexual behavioral norms, past-political centralization. Ethnic colonial controls: split across country borders, current minority status. Location controls: density, luminosity at night, elevation, distance to water, to the sea, and to capital city, existence of natural resources (diamond mines, petroleum plants), recent experience of conflicts, violence and riots, disease environment using the malaria stability index. *$*p < 0.10$, **$p < 0.05$, ***$p < 0.01$.*

Table II: LPM Estimates of the Determinants of ITN Use and Anemia Hemoglobin Test Consent

	Use Malaria ITN Net	Accept Anemia Test
	(1)	(2)
Group exports slaves (=1)	-0.0019	-0.0250***
	(0.0142)	(0.0083)
Child controls	Yes	Yes
Mother controls	Yes	Yes
Household controls	Yes	Yes
Ethnic pre-colonial controls	Yes	Yes
Ethnic colonial controls	Yes	Yes
Location x Survey-Year FE	Yes	Yes
Adj. R-Squared	0.338	0.204
N observations	82199	31471
Number of ethnicity clusters	59	45
Number of area clusters	6884	4326

The table reports LPM estimates. Standard errors are adjusted for clustering within ethnic groups. Child controls include: sex of the child, the order of birth, a dummy for home delivery. Mother controls: education, literacy status, employment status, religion, age, access to health facility, total children, birth interval, ideal number of children, unwanted births, watch TV, listen to radio. Household controls: father employment status, the gender of the houshold head, the household wealth index, mother makes health decision. Ethnic pre-colonial controls include dummies for norms of: child heredity, postpartum sex taboo, rigidity of girls premarital sexual behavioral norms, past-political centralization. Ethnic colonial controls: split across country borders, current minority status. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table III: LPM Estimates of the Determinants of Measles Vaccination, Cultural Transmission Mechanisms

Dep.Var:	Measles Vaccine			
	(1)	(2)	(3)	(4)
Panel A: Preferences for traditional practices				
Group exports slaves (=1)	-0.0457**	-0.0595***	-0.0427**	-0.0444*
	(0.0206)	(0.0213)	(0.0205)	(0.0227)
Group exports slaves (=1) X Traditional religion (=1)	-0.0708**			
	(0.0334)			
Group exports slaves (=1) X Muslim (=1)		0.0312		
		(0.0201)		
Group exports slaves (=1) X Catholics (=1)			-0.0208	
			(0.0133)	
Group exports slaves (=1) X Protestants (=1)				-0.0033
				(0.0131)
Baseline controls	Yes	Yes	Yes	Yes
Location x Survey-Year FE	Yes	Yes	Yes	Yes
Observations	81280	81280	81280	81280
Adj. R-squared	0.210	0.210	0.210	0.210
Panel B: Values of children's welfare				
Group exports slaves(=1)	-0.0398**	-0.0349*		
	(0.0183)	(0.0189)		
Group exports slaves(=1) X Hereditary political succession (=1)	-0.0141			
	(0.0351)			
Group exports slaves(=1) X Matriarchy (=1)		-0.1700***		
		(0.0514)		
Baesline controls	Yes	Yes		
Location x Survey-Year FE	Yes	Yes		
Observations	81280	81280		
Adj.R-squared	0.210	0.210		

The table reports LPM estimates. Standard errors are reported in parentheses and adjusted for clustering within ethnic groups. Panel A and Panel B are estimated as in our baseline controls where child controls include: sex of the child, the order of birth, a dummy for home delivery. Mother controls: education, literacy status, employment status, religion, age, access to health facility, total children, birth interval, ideal number of children, unwanted births, watch TV, listen to radio. Household controls: father employment status, the gender of the houshold head, the household wealth index, mother makes health decision. Ethnic pre-colonial controls include dummies for norms of: child heredity, postpartum sex taboo, rigidity of girls premarital sexual behavioral norms, past-political centralization. Ethnic colonial controls: split across country borders, current minority status. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Table IV: Variable description and data source

Variables	**Description**	**Source**
Group exports slaves	Dummy variable for ethnic groups exporting slaves	Nunn and Wantchekon (2011)
Employment	Dummy variables for parents' employment	Demographic Health Survey
Mother age	Reported age of the mother	Demographic Health Survey
Mother education	Reported number of education years	Demographic Health Survey
Literacy	Categorical variable for effective ability to read during survey	Demographic Health Survey
Female household head	Dummy variable for households headed by females	Demographic Health Survey
Mother makes health decisions	Dummy for child health decisions made by the mother	Demographic Health Survey
Wealth Index	Categorical variable for the household level of income	Demographic Health Survey
Listen to radio	Frequency of listening to radio	Demographic Health Survey
Watch TV	Frequency of watching TV	Demographic Health Survey
Religion	Categorical variable for the reported religion	Demographic Health Survey
Total births	Categorical variable for the mother's life time birth records	Demographic Health Survey
Close pregnancies (last 5 years)	Number of births during the last five years	Demographic Health Survey
Ideal number of children	Mothers reported ideal number of children	Demographic Health Survey
Not wanted last child	Dummy variable for undesired last child	Demographic Health Survey
Distance to health facility	Dummy variable for distance to health facility is a problem	Demographic Health Survey
Child birth order	Categorical variable for the child birth order	Demographic Health Survey
Sex of child	Dummy variable for female child	Demographic Health Survey
Home delivery	Dummy variable for a child delivery at home instead of medical facility	Demographic Health Survey
Ethnic Centralization	Dummy for ethnic group precolonial political centralization	Murdock Ethnographic Atlas (1967)
Split ethnic group	Ethnic group split during colonial period	Michalopoulos and Papaioannou (2016)
Ethnic minority status	Dummy variable coded for groups outside majority	Demographic Health Survey
Child Hereditary Succession	Dummy variable coded from indicator on type of political hereditary succession	Murdock Ethnographic Atlas (1967)
Matriarchy	Dummy variable for child matrilineal political succession	Murdock Ethnographic Atlas (1967)
Postpartum sex-taboos	Dummy variable coded from indicator on historical norms of postpartum sex-taboos	Murdock Ethnographic Atlas (1967)
Rigidity of sexual norms	Dummy variable coded from indicator on historical norms of premarital sexual behavior of girls	Murdock Ethnographic Atlas (1967)

Table V: Summary statistics

	Obs.	Mean	S.d.	Min.	Max.
Child variables					
Sex of child	157405	0.49	0.50	0	1
Birth order (Age < 5 years)	157405	2.12	0.72	1	3
Child home delivery	156610	0.43	0.50	0	1
Measles	144375	0.62	0.49	0	1
Mother and household variables					
Female household head	101866	0.20	0.40	0	1
Mother Age	101866	28	7.19	15	49
Mother employed	97589	0.67	0.47	0	1
Mother education years	101866	4	1.59	0	8
Mother literacy	95390	0.41	0.49	0	1
Health decisions female	80016	0.48	0.50	0	1
Problem distant health services	134258	0.46	0.50	0	1
Accept hemoglobin test	35019	0.97	0.17	0	1
Adult sleep under net	90474	0.49	0.50	0	1
Total births last 5 years	101866	1.49	0.62	1	5
Ideal number of children	90919	5.59	2.75	0	40
Non desired last child	97461	0.26	0.44	0	1
Total children	101866	3.81	2.48	1	17
Father employed	91558	0.99	0.10	0	1
Wealth Index	95891	2.79	1.41	1	5
Listen to radio	95784	0.65	0.48	0	1
Watch TV	95756	0.39	0.49	0	1
Muslim	101722	0.43	0.49	0	1
Catholics	101722	0.19	0.39	0	1
Protestants	101722	0.33	0.47	0	1
Traditionnal religion	101722	0.03	0.17	0	1
Ethnic group variables					
Ethnic group exports slaves	101866	0.80	0.40	0	1
Ethnic centralization	82367	0.66	0.48	0	1
Ethnic child heredity	101866	0.44	0.50	0	1
Ethnic matriarcat	84366	0.17	0.38	0	1
Ethnic post-partum sex taboo	101866	0.30	0.46	0	1
Ethnic rigidity of sexual norms	101866	0.22	0.42	0	1
Ethnic colonial Split	101866	0.52	0.50	0	1
Ethnic minority	101866	0.61	0.49	0	1

Table VI: Summary statistics at the location (cluster) level

	Obs.	Mean	S.d.	Min.	Max.
Number of ethnic groups	9726	1.70	0.87	1	7
Number of children	9726	16.18	11.92	1	91
Number of mothers	9726	11.08	7.42	1	54
Measles vacc. rate	9707	0.66	0.25	0	1
Group exports slaves	9726	0.80	0.37	0	1

Table VII: LPM Estimates of the Determinants of Measles Vaccination

	Measles
Ethnic group exports slave	-0.0457**
	(0.0206)
Ethnic group Pre-colonial centralization	-0.0257**
	(0.0105)
Split ethnic group during colonial period	-0.0127
	(0.0087)
Minority group	0.0217*
	(0.0110)
Pre-colonial Cultural Norms of Child Investment: Type of Hereditary Succession	
Child Heredity	0.0326**
	(0.0140)
Pre-colonial Cultural Norms of Preventative behavior	
Postpartum sex taboo	0.0312***
	(0.0081)
Insistence on early female marriage or on girls virginity	0.0348***
	(0.0123)
Household socio-demographics:	
Father employed (=1)	0.0174
	(0.0170)
Mother employed (=1)	0.0465***
	(0.0062)
Mother Age	0.0629***
	(0.0060)
Mother education (years)	0.0009
	(0.0015)
Mother Literacy (Ref:Not able to read)	
Read partially	0.0202***
	(0.0068)
Read adequately	0.0376***
	(0.0055)
Distance to health facility is a problem(=1)	-0.0154**
	(0.0063)
Female household head	-0.0137**
	(0.0062)
Mother makes health decisions	0.0100***
	(0.0037)
Listen to radio	0.0061**
	(0.0023)
Watch Tv	0.0072
	(0.0043)
continued in Table VIII	

Table VIII: LPM Estimates of the Determinants of Measles Vaccination (continued)

Wealth Index Quantile (Ref:poorest)	
2nd quantile	0.0085
	(0.0053)
3rd quantile	0.0193***
	(0.0062)
4th quantile	0.0355***
	(0.0097)
5th quantile	0.0504***
	(0.0127)
Religion (ref:Muslim)	
Catholic	0.0176
	(0.0110)
Protestant	0.0062
	(0.0091)
Traditional	-0.0296*
	(0.0152)
Others	-0.0238
	(0.0147)
Mother Births History(Ref: ≤2)	
Life time total births (3/4)	0.0805***
	(0.0069)
Life time total births (≥5)	0.2133***
	(0.0131)
Close Births (last 5 years)	-0.0510***
	(0.0045)
Mother fertility preferences	
Ideal number of children (N)	0.0023**
	(0.0011)
Not wanted last children	0.0011
	(0.0050)
Child birth order (Ref: ≤2)	
Birth order (2/4)	-0.1172***
	(0.0105)
Birth order (5/18)	-0.3088***
	(0.0225)
Sex of child (female=1)	0.0088***
	(0.0033)
Home delivery (=1)	-0.0289**
	(0.0143)
Location x Survey-Year FE	Yes
Adj. R-Squared	0.210
N Observations	81280

The table reports LPM estimates of the remaining explanatory variables in the baseline estimation in column (2) of Table I. Standard errors are reported in parentheses and adjusted for clustering within ethnic groups as in our baseline specification in column (2) of Table I. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.