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Foreign aid and teenage childbearing

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Abstract: Teenage childbearing has serious consequences for young mothers, their children, and society. This study estimates the impact of foreign aid projects on teenage fertility in Malawi. We combine georeferenced data on aid projects from 1998–2016 with individual-level fertility data. Identification relies on spatial and temporal variation in aid exposure and survey timing, with controls for project placement and teenage childbearing among older women not exposed to the intervention. Results show that aid to sexual and reproductive health, HIV/AIDS, and education significantly reduce teenage fertility, while other aid types have limited effects. Women who were exposed to relevant aid while of critical age were 15-25 percent less likely to have given birth as teenagers. Likely mediators include increased time in school, delayed entry into relationships, and postponed marriage.

JEL classifications: F35, O12, O15

Keywords: Teenage fertility; Early childbearing; Foreign aid, Malawi

1. Introduction

Around the world, an estimated 12 million girls aged 15–19 give birth annually (Wado et al., 2019). Teenage childbearing is particularly common in Sub-Saharan Africa, where in many countries more than a quarter of girls give birth before age 18 (UNICEF, 2024). Early childbearing can result in a range of harmful consequences for the mother, child, and society at large (Grønvik and Fossgard Sandøy, 2018; Sunder, 2019). Teenage pregnancy increases the risk of pregnancy complications, including death (UNICEF, 2024), and often leads to school dropout, with lifelong consequences for human capital and income (Eloundou-Enyegue, 2004; Almanza and Sahn, 2018; Psaki et al., 2019; Berthelon et al., 2025). Moreover, teenage childbearing can perpetuate an intergenerational cycle of poverty and disadvantage, as the children of teenage mothers tend to experience worse health, education, and economic outcomes and are more likely to become teenage parents themselves (Kalulu et al., 2024).

The establishment of the United Nations Fund for Population Activities (UNFPA) in 1969 and the 1994 International Conference on Population and Development (ICPD) increased focus on reproductive health in the international community (Malawi Government, 2009; Piva and Dodd, 2009), and international aid agencies have funded numerous family planning and reproductive health projects over the years, with a reduction in teenage pregnancies being a key objective (Kibira et al., 2021; Ekman et al., 2023).

Studies of aid efficiency have a long history in development research (for an overview of earlier literature, see e.g., Clemens et al., 2012) but are especially relevant now given recent large-scale cuts to aid financing by the US, the UK (Gulland, 2025), and other donors. As funding becomes more limited, it will be essential to focus on programs that deliver results. It is therefore crucial to understand how aid programs work and what effects they have, including their impact on teenage fertility.

The aim of this paper is to estimate the local effects of aid on teenage childbearing in Malawi, which has one of the highest teenage fertility rates in the world (World Bank, 2024). In 2020, 29% of women aged 20-24 had given birth before their 18th birthday (UNICEF, 2024). Malawi also has the most complete geo-referenced record of aid projects from a broad range of donors, allowing for a detailed and disaggregated analysis of local aid flows.

We focus on aid projects that are likely to affect teenage fertility, specifically projects on sexual and reproductive health (SRH), HIV/AIDS, and education. The former often includes family planning projects aiming directly to reduce teenage fertility, HIV/AIDS projects may

result in increased condom use and abstinence or reduced number of sex partners, and education projects can both increase relevant knowledge and lead to fewer pregnancies by keeping girls in school longer. For comparative purposes, and since aid could affect teenage fertility through various channels, such as improved employment opportunities, we also consider other major aid sectors. In addition, given that the consequences of teen fertility are likely to vary depending on the age of the mother, we examine effects on childbearing before each age between 15 and 20. Finally, we explore possible mechanisms underlying the results.

We geographically match spatial data on aid projects in Malawi with respondents from two Malawi Demographic and Health Surveys (DHSs). In the benchmark specifications, we classify girls as exposed to aid if they were 12-16 years old when there was an ongoing project located within 10 km of their survey cluster. We argue that ages 12 to 16 are a critical period when access to SRH, HIV/AIDS, and education projects could have a significant impact, since it is a period when many have their sexual debut and when the earliest childbirth occurs. It is also a period during which interventions to keep girls in school can be impactful, as it covers the transition to secondary school, a phase when school dropout is common (Herrera Almanza and Sahn, 2018; McLean et al. 2024a). However, we consider exposure at younger ages in some specifications to check for robustness. We also consider alternatives to the 10 km exposure cut-off in robustness checks.[1]

To identify the effect of aid projects, we rely on spatial and temporal variation in aid project coverage, coupled with variation in the girls' birth year in relation to project start. We use 272 x "55x55" km grid-cell-by-survey-year and birth year fixed effects. To further reduce potential selection bias, within grid-cells, we control for historical teenage childbearing in the cluster and factors related to the allocation of aid projects. Additionally, we employ matching to verify the robustness of our results.

The empirical results consistently indicate a substantial impact of aid projects on teenage childbearing. Girls exposed to SRH-, HIV/AIDS- and education projects are 15% to 25% less likely to give birth as teenagers. Among the mechanisms we can evaluate, delayed marriage, the probability of never having been in a relationship, and increased time in school are the most likely candidates; we do not find any effects on the age of first sexual encounter or use of modern contraceptives.

[1] Given the random offset of GPS coordinates within a 5 km radius, we do not use a smaller cut-off. Other studies on aid in Malawi also use a 10 km radius, e.g., Durevall and Isaksson (2024).

To the best of our knowledge, only one previous study evaluates how foreign aid affects teenage pregnancy (Zhuang, Wang, and Daniels, 2020). It uses cross-country data and finds that aid is associated with lower teenage fertility, with this relationship being stronger for health and education aid than for other types of aid. A larger body of research focuses on specific interventions, usually financed totally or partly by donors. Several reviews report that interventions aimed at teenagers' reproductive health, such as education about sexual and reproductive health, counseling, and provision of contraceptives, might be effective in reducing teenage pregnancies (McKenry et al., 1979; Salam et al., 2016; Peterson et al., 2019; Vaivada et al., 2022). However, the evidence is mixed. A detailed review of high-quality studies with pregnancy as an outcome found that pregnancy rates were significantly reduced in seven cases, while the results were uncertain in two studies and insignificant in five. One intervention even increased the rate of pregnancy (Hindin et al., 2016). However, the authors note that pregnancy is likely to be underreported, especially if it ends in abortion, and that some interventions with null findings were likely not reported.

While studies on interventions provide valuable knowledge about the impact of specific projects, they are less informative about the average effects of different projects that could reduce teenage childbearing. Moreover, although generally strong in terms of internal validity, micro-level studies focusing on establishing the causal impact of specific interventions raise concerns about external validity and the extent to which findings can be scaled up and extrapolated from one site to others (Menaldo and Prakash, 2014).

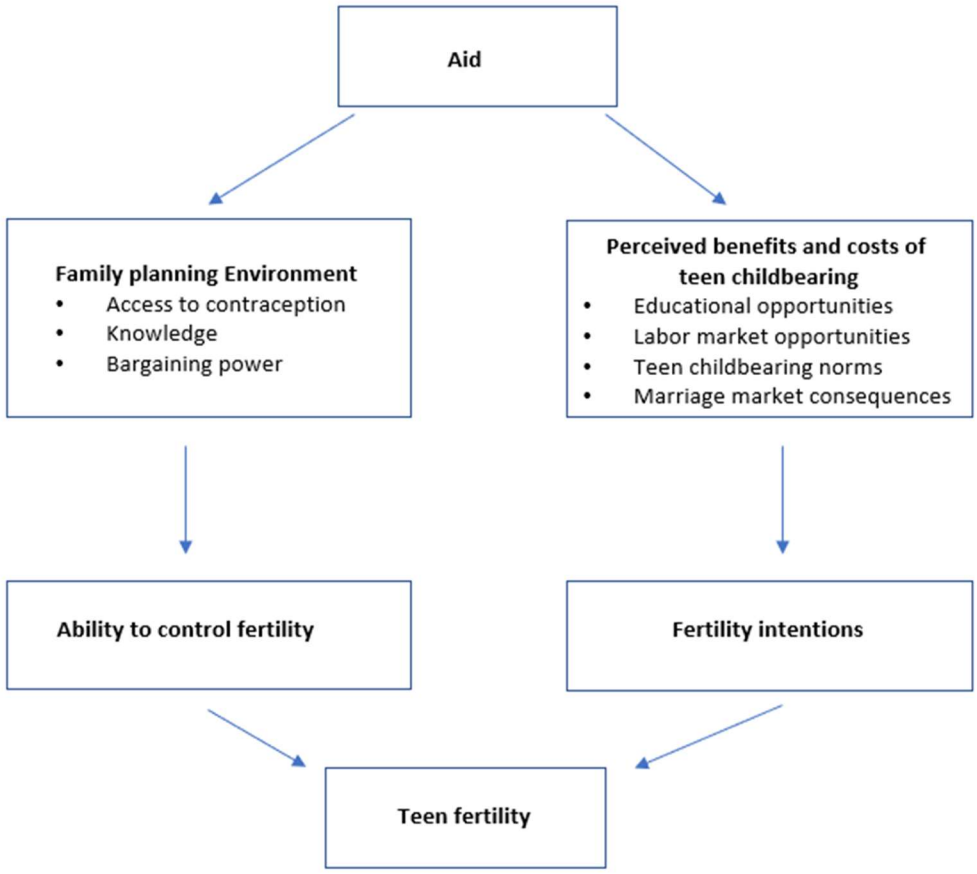
We contribute to the literature by using geocoded aid and outcome data to focus on local within-country effects of aid on teenage fertility. Sub-national analysis offers a complementary and intermediate perspective. Rather than estimating country-wide impacts of foreign aid or analyzing the impact of specific interventions, our strategy enables us to systematically estimate whether the many implemented aid-financed projects have effects on average. A growing body of literature uses geocoded data to explore the local effects of aid,[2] but to our knowledge, this is the first study on the local effects of aid on teenage childbearing.

[2] Recent examples include Bluhm et al. (2024), Durevall and Isaksson (2024), and Wellner et al. (2025)

2. Drivers of teenage fertility

There is a rich literature across disciplines on the determinants of total fertility and fertility timing, where fertility timing is particularly relevant for teenage fertility (ACERWC, 2022). In broad terms, determinants can be divided into factors that shape fertility intentions and the possibility to control fertility to achieve fertility intentions. These factors are summarized in Figure 1, our conceptual framework.

Figure 1. Conceptual framework



More than 50% of teen pregnancies worldwide are unintended, while the proportion of unwanted births is smaller since some unintended pregnancies end in abortions (both legal and illegal) (Sully et al., 2019). The large share of unwanted pregnancies suggests that teenage girls often lack adequate reproductive knowledge and/or access to essential reproductive health services. Indeed, some adolescents are not aware of how fertility fluctuates during the menstrual cycle (Harada et al., 2024). Studies also show that the unmet need for family

planning is greater among teenagers than among women in general (Miller, 2010; Sully et al., 2020), and evidence from some African countries shows that when family planning services are made accessible to adolescents, they can contribute to reduced fertility rates (Branson and Byker, 2018).

The ability of young women to control fertility and achieve fertility intentions may also be constrained by gender inequality and unequal power dynamics. Many young women lack the bargaining power to negotiate safe sex within their relationships and may face pressure from families or communities to enter early marriages (World Bank, 2016; Nabugoomu et al., 2020; Gillespie et al., 2022).

Recent studies focusing on teenage girls in Malawi reinforce these findings. They identify limited knowledge about preventing pregnancy, low acceptance and use of contraceptives, restricted access to family planning, financial hardship, neglect by parents, sexual abuse, and pressure to support their families through early marriage or transactional sex as the primary factors contributing to teen pregnancy (Malawi Government, 2015; Chamdimba et al., 2023; Harada et al., 2024).

Turning to intended fertility, adolescent childbearing is intrinsically linked with marriage age and education decisions (Glynn et al., 2018; Bain et al., 2022). Hence, educational opportunities and marriage market consequences are key factors. Early childbearing is generally influenced by the possible future that teenage girls see for themselves, and young girls may view motherhood as an alternative to pursuing education and careers if educational and economic opportunities are lacking, which is often the case in poor communities. In fact, there is now ample evidence from African countries that improved educational opportunities decrease teenage fertility (Osili and Long, 2008; Herrera Almanza and Sahn, 2018; Adu Boahen and Yamauchi, 2018; Gebre, 2020; Keats, 2018; Lindskog and Durevall, 2021; Chicoine, 2021; Muchiri, 2021).

Relatedly, teenage fertility is linked to poverty (Baird, McIntosh and Özler 2011; Kalulu et al., 2024). Beyond the consequences on intended fertility of poor educational and future income-earning opportunities, poverty may affect teen fertility through transactional sex, where women can find it difficult to negotiate safe sex, and consequently to achieve fertility intentions. (Tawfik and Watkins, 2007; Stoebenau et al., 2016; Nabugoomu, et al., 2020).

Thus, aid projects can affect teenage childbearing through various channels. In the main analysis, we focus on aid projects that are likely to be particularly important – sexual and

reproductive health, HIV/AIDS, and education projects. While it is not possible to make a clear-cut distinction regarding the mechanisms through which projects work, SRH and HIV/AIDS projects can be expected to reduce unwanted pregnancies, and education projects could be expected to affect fertility intentions by offering girls a better future if staying in school. For comparative purposes, we also estimate the impacts of other aid projects, which could have indirect effects, e.g. via increased income. After having established the impacts of aid projects, we move on to investigate some potential intermediate outcomes.

3. Data and Empirical Strategy

We geographically match spatial data on aid projects spanning the period 1998–2016 from AidData,[3] with respondents from two rounds of the Malawi Demographic and Health Survey, 2010 and 2015–16 (see MDHS 2011, MDHS 2017). The aid project database includes information from 30 donor agencies, representing about 80% of the total external assistance to Malawi reported to the government from 2000 to 2011 (Peratsakis et al., 2012). It contains project coordinates, as well as information about the precision of the identified location (AidData Research and Evaluation Unit, 2017). As we are interested in the local effects of aid projects, we focus on projects with an exact location or coded as 'near', in the 'area' of, or up to 25 km away from an exact location.[4] After initial sample restrictions (focusing on projects with necessary information on start and end dates), these criteria apply to 49 percent of the project sites. Specifically, we cover projects from 22 donors spread across 778 aid project sites (Table A1 in Appendix A). Importantly, the aid projects we cover do not represent all aid to Malawi. Focusing on aid projects with precise geo-codes implies that we restrict our attention to projects with tangible project sites, rather than budget or sector support. Thus, we capture variation in local aid exposure that exists beyond aid coverage at more aggregate levels (see the discussion in Appendix B).

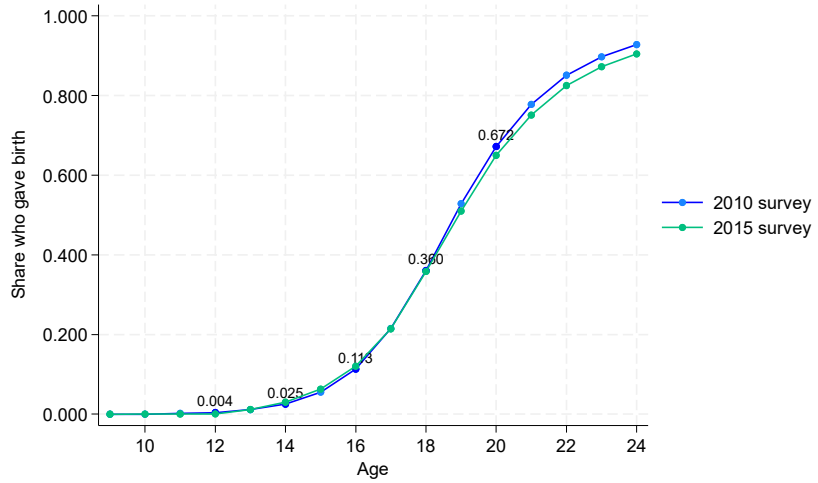
We use the coordinates of the DHS clusters[5] to match surveyed women to aid project sites; that is, we measure the distance from the cluster center points to the aid project sites and

[3] Referring to the earliest recorded start year and the latest recorded end year among the projects in our sample. The dataset is from 2012, so the end dates after that refer to the planned date of completion.
[4] Precision categories 1 and 2 in Strandow et al. (2011).
[5] The primary sampling unit in the DHS (usually based on census enumeration areas), is often villages in rural areas or city blocks in urban areas (Burgert et al., 2013). To ensure respondent confidentiality, the DHS randomly displaces the GPS positions for all surveys, so that urban clusters contain a minimum of 0 and a maximum of 2 kilometers of error and rural clusters contain a minimum of 0 and a maximum of 5 kilometers of positional error,

identify the clusters with at least one project site located within 10km in the benchmark setup. In Appendix C, we demonstrate that the exact choice of cut-off does not impact on the results between 5 km and 15/20 km, while results are weaker with a 25 km cut-off (when a large share of girls is classified as treated).

The primary outcome variable is whether a woman who was 20 years or older at the time of the survey gave birth when she was 13-19 years.[6] As can be seen in Figure 2, about 9% had a child before they turned 16, 18% before they turned 17, and 62% before they turned 20. Thus, more than half of the women in Malawi become mothers as teenagers. Since the consequences of teenage childbearing are likely to be worse the younger the girl is, we also estimate models of childbearing before the age of 15, 16, 17, 18, and 19 years.[7]

Figure 2: Cumulative shares of women aged 25-34 who gave birth between ages 9-24



Source: Malawi DHS 2010 and 2015/1

with a further 1% of the rural clusters displaced by a minimum of 0 and a maximum of 10 kilometers (DHS, 2023). This should attenuate but not bias our estimates.

[6] This outcome differs from many other studies that analyse childbearing among women who are under 20 years, i.e., usually among 15-19-year-old girls (Kassa et al., 2018). Such an approach ignores that, for example, a 16-year-old girl might give birth when she is 17 or 18. By using retrospective data reported by women 20 years and older, we get a more complete picture of teenage childbearing (Kalulu et al., 2024). We exclude the very few births before age 13 (42 observations) since, given the nine months between conception and birth, aid exposure at ages 12-16 should not have impacted these. Including the 42 births before age 13 does not change the results, however.

[7] Although the legal marriage age is 18 in Malawi, having children at 18 and 19 are likely to affect schooling negatively.

Our treatment variable should capture exposure to relevant aid projects during a critical period in the girls' lives. As discussed in Section 2, we focus on projects in SRH, HIV/AIDS, and education. Table A2 shows the distribution of all aid projects across sectors. We utilize all education projects, as it is unclear if some are more relevant than others. For example, both primary school- and secondary school projects could affect the transition to secondary school. In the health sector, on the other hand, some projects are clearly more relevant than others. Thus, within the health sector, we construct a measure of aid broadly targeted at teenagers' sexual and reproductive health (SRH), using DAC's purpose codes for "population policies" and "HIV/AIDS". We denote this SRH-HIV in the rest of the paper. Additionally, we examine the impact of all other major aid sectors jointly.

At what age aid exposure might affect current or future childbearing does, to some extent, depend on the type of aid project. Since we focus on SRH-HIV and education projects, we should use an age span when these are likely to matter. In the main estimations, we use exposure between ages 12 and 16, primarily since this is an age when many women have their first sexual encounter (see Table A3) and when early births start to occur (see Figure 2). Moreover, family planning services for youth in Malawi target sexually active youth (Malawi Government, 2009). While they may include girls as young as 10 (WHO, 2002), very few seem to be sexually active at that age.[8] Among 20-30-year-old women in the data, only 1.42% report an age at first sex below 12 years. In addition, social norms probably prevent many young girls from accessing family planning, though they may be exposed to HIV/AIDS projects that, for example, may include information campaigns. By the age of 16, over 50% report to have had their sexual debut, while close to one in four reported having given birth at age 16 or before (Figure 2). Hence, ages 12-16 is a range when aid projects could influence girls through improved knowledge and access to contraceptives. It is also an age range when education projects that keep girls in school could delay childbearing. In Malawi, a key factor is the transition to secondary school, which usually occurs at the age of 14. Secondary school lasts four years, leading to the Malawi School Certificate of Education (MSCE) exams.

Considerations of data availability also influence our choice of the exposure age window. The data on aid projects in Malawi span projects from 1998 to 2016, and the latest MDHS is from 2015/16. Since we do not want to include women who may have been exposed to relevant

[8] A recent study of Youth-Friendly Health Services in Malawy focussed on girls older than 14 years (MEASURE Evaluation., 2019).

projects that began before 1998, we cannot investigate the impacts of exposure at very early ages. The younger the exposure age, the smaller the estimation sample. The oldest birth cohort observed from age 12 within the 1998-2016 period was born in 1986. However, to reduce contamination bias from ongoing projects that started before 1998, we include only women who were 12 years old or younger in 1990. The last MDHS survey was carried out in 2015/2016, meaning the oldest birth cohort we observe until they turn 20 was born in 1995. Hence, our estimation sample is women born in 1990-1995.

If we want to consider projects that could bring about long-lasting improvements in economic opportunities, it is harder to determine at what age exposure should be most important. We therefore expect measures of exposure to such projects or to aid projects in general to be noisier than measures of exposure to SRH, HIV/AIDS, and education projects.

Girls are classified as exposed to aid if an ongoing project was located within 10 km of the survey cluster when they were between 12 and 16 years old. We estimate separate effects for exposure to a relevant aid project during the whole 12–16-year period and for exposure during part of the period (one to four years). The comparison group is women who were not exposed to a relevant aid project at all between the ages of 12 and 16.

Migration could be a source of measurement error in our treatment variable. The DHS has information about the location in which the respondent currently lives and how long they have lived there. Since this information does not reveal exact migration patterns, we run estimations using three alternative samples. In the first estimation sample, we include all women in the relevant age range, independent of how long they have lived in their current location. The reason for including women who did not live exactly in their current location at ages 12-16 is that we can expect most of them to have moved only a short distance.[9] In the second sample, we include only women who lived in their current place of residence at least since they were 15 years old, i.e., we know their exposure status during at least one year. In the third sample, we include only women who lived in their current place of residence at least since they were 12 years old (i.e., we know that they resided there during the entire 12-16 age range). It is unclear which of these estimation samples is the best. While measurement error in treatment status should be largest

[9] A recent study on migration among young people in Northern Malawi distinguishes between short and long moves. Long moves were over 4.6 km (McLean et al., 2024b); therefore, it is likely that very few individuals moved outside our treatment areas. It is worth noting that the main ethnic group in the sample was Tumboka, which follows a patrilineal custom where women typically move to their husband's village upon marriage. However, many female adolescents moved to relatives. In other parts of Malawi, the husbands move to the wife's village, so newly married females are likely to move even shorter distances there than in Northern Malawi.

in the first sample and smallest in the last, representativeness is largest in the first, and smallest in the last, most restricted, sample. Furthermore, we have most statistical power the first and largest sample.

Turning to control variables, we control flexibly for differences in teenage childbearing across space and time using 272 '55×55' km grid-cell-by-survey-year fixed effects, as well as birth-year fixed effects. Since the allocation of aid projects within grid-cells is not random, we add several variables to capture possible within-grid-cell selection. We account for historical differences in teen childbearing using the proportion of women aged 35 and older who gave birth before age 18 in each cluster. Moreover, the literature on the determinants of aid allocation has found that the president's ethnicity and existing health infrastructure are significant factors (Marty et al., 2017; Khomba and Trew, 2022). We, therefore, include variables that identify clusters where at least 75% of the population belongs to the following ethnic groups: the Lomwe, Yao, and Chewa,[10] and urban-rural residence interacted with a dummy variable indicating accessibility to a health clinic. In addition, we control for urban versus rural residence, accessibility to a health clinic, religion, and ethnicity.

Our benchmark linear probability specification takes the following form,

$$Y_{ivgt} = \beta Treated_{vgt} + \alpha_g + \gamma \cdot \boldsymbol{X}_{ivgt} + \varepsilon_{ivgt} \quad (1)$$

where the outcome *Y,* whether a woman *i* in cluster *v* and grid cell *g* born in year *t* gave birth as a teenager, is regressed on the treatment dummy $Treated$ indicating if the women had an active aid project within 10 km while aged 12-16 years, α, grid-cell-by-survey-year fixed effects, and **X** is a vector of the above listed control variables at individual and survey cluster level. The error term ε is clustered by survey cluster.

Finding that aid projects affect teenage childbearing, it is interesting to investigate possible mechanisms. We estimate the relationship between aid exposure and variables known to affect teenage childbearing and which are available in our data: education, age at first marriage and sexual debut, ever having had a partner, and the use of modern contraceptives. To see if there is a change in attitudes towards childbearing, we also consider the relationship between aid exposure and the preferred waiting time before having the next child.

[10] The following were presidents during the study period. Bakili Muluzi (1994–2004): Muluzi is of the Yao ethnic group. Bingu wa Mutharika (2004–2012): Mutharika was from the Lomwe ethnic group. Joyce Banda (2012–2014): Joyce Banda is from the Chewa ethnic group. She is married to a Lomwe. Peter Mutharika (2014–2020): Peter Mutharika is also from the Lomwe ethnic group.

Further variable descriptions and descriptive statistics can be found in the Appendix. In Table A4 we present a list of variable descriptions. In Table A5 we report the shares of sample women who were exposed to relevant aid projects between the age of 12 and 16.[11] About 74% of the girls were exposed to any aid project, while 23% were exposed to SRH-HIV (15% part of the period, and 8% the full period) and 18% to education projects (13% part of the period, 5% the full period). Furthermore, around 12% were exposed to both SRH-HIV and education aid all (partially or fully).

4. Results

The results consistently suggest that aid to SRH-HIV and education significantly reduce teenage fertility, while other aid types have limited effects. Table 1 summarizes the main results, for the full sample, for the sample of women who lived in their current location at least since age 15, and for the sample of women who lived in their current location at least since age 12.

Table 1. Linear probability models of teenage childbearing on exposure to SRH-HIV-, education-, and any aid.

Sample	(1) Full sample	(2) Lived in location since age 15	(3) Lived in location since age 12	(4) Full sample	(5) Lived in location since age 15	(6) Lived in location since age 12	(7) Full sample	(8) Lived in location since age 15	(9) Lived in location since age 12
SRH-HIV	-0.066***	-0.073***	-0.062**						
	(0.020)	(0.026)	(0.026)						
EDU				-0.073***	-0.086***	-0.072**			
				(0.025)	(0.030)	(0.030)			
AID							-0.031*	-0.031*	-0.018
							(0.016)	(0.018)	(0.019)
Constant	0.642***	0.716***	0.698***	0.652***	0.725***	0.707***	0.660***	0.732***	0.706***
	(0.030)	(0.036)	(0.039)	(0.030)	(0.037)	(0.040)	(0.032)	(0.039)	(0.042)
Mean dep. variable	0.620	0.660	0.640	0.620	0.660	0.640	0.620	0.660	0.640
Observations	6,445	4,114	3,659	6,445	4,114	3,659	6,445	4,114	3,659
R-squared	0.098	0.121	0.131	0.098	0.121	0.131	0.096	0.119	0.130

Note. Linear probability models with robust standard errors clustered at the survey-year cluster level. The dependent variable is teenage childbearing (ages 13-19). Exposure is meased between age 12-16. All regressions control for birth year, religion, ethnicity, urban residence, ease of access to a health clinic, urban-clinic nearby interaction term, dominance of the president's ethnic group, Chewa, Yao, and Lomwe, the cluster share of women over 35 who gave birth before turning 18, and grid-cell by year fixed effects. *** p<0.01, ** p<0.05, * p<0.1.

[11] We use all the observations independent on how long women have lived in their current location. The distribution changes little when we exclude women who moved to their current location after age 15 or 12.

The estimated effects of exposure to SRH-HIV or education projects are negative and statistically significant in all regressions. The effect sizes vary slightly but are similar across the three samples. Women exposed to such aid projects while aged 12-16 are roughly 6-9 percentage points less likely than women not exposed during this period to have a child before age 20. These numbers are large, even though about 60% of the women in the sample gave birth as teenagers. The results for all aid are weaker; the estimates are closer to zero and only statistically significant at the 10% level.[12]

To assess heterogeneity by treatment intensity, in alternative estimations we use separate treatment variables if the area was exposed to the concerned project type during the entire period when the respondent was aged 12-16 or only during parts of it. Although admittedly a crude measure of treatment intensity, reassuringly the results, presented in Table 2, as expected suggest that the estimated effects of full exposure are stronger than those of partial exposure. The estimates vary between 10 and 17 percentage points for full exposure to SRH-HIV or education aid project, statistically significant at the one percent level across all sub-samples. The estimated effects of partial treatment are in the 4 to 6 percentage points range and statistically significant at the 5% level only in the full sample. The estimates of the impact of all aid projects do not change much when considering intensity.

Table 2. Intensity of treatment. Linear probability models of teenage childbearing on partial or full exposure to SRH-HIV education-, and any aid.

Sample	(1) Full sample	(2) Lived in location since age 15	(3) Lived in location since age 12	(4) Full sample	(5) Lived in location since age 15	(6) Lived in location since age 12	(7) Full sample	(8) Lived in location since age 15	(9) Lived in location since age 12
SRH-HIV_part	-0.052**	-0.048*	-0.040						
	(0.021)	(0.027)	(0.027)						
SRH-HIV_all	-0.108***	-0.163***	-0.144***						
	(0.033)	(0.043)	(0.046)						
EDU_part				-0.063**	-0.045	-0.036			
				(0.026)	(0.031)	(0.032)			
EDU_all				-0.098***	-0.173***	-0.149***			
				(0.038)	(0.049)	(0.050)			
AID_part							-0.018	-0.023	-0.008

[12] Table A6 shows that the estimates for the other aid sectors are mostly statistically insignificant. The possible exceptions are health and infrastructure. However, the health effect is driven by SRH-HIV projects, and the estimates for infrastructure are unstable across specifications.

							(0.019)	(0.021)	(0.023)
AID_all							-0.042**	-0.037*	-0.025
							(0.018)	(0.020)	(0.022)
Constant	0.643***	0.717***	0.700***	0.650***	0.721***	0.702***	0.657***	0.729***	0.704***
	(0.029)	(0.036)	(0.039)	(0.030)	(0.037)	(0.040)	(0.032)	(0.039)	(0.042)
Mean dep. variable	0.620	0.660	0.640	0.620	0.660	0.640	0.620	0.660	0.640
Observations	6,445	4,114	3,659	6,445	4,114	3,659	6,445	4,114	3,659
R-squared	0.098	0.122	0.132	0.098	0.123	0.133	0.097	0.119	0.130

Note. Linear probability models with robust standard errors clustered at the survey-year cluster level. The dependent variable is teenage childbearing (ages 13-19). Exposure is meased between age 12-16. All regressions control for birth year, religion, ethnicity, urban residence, ease of access to a health clinic, urban-clinic nearby interaction term, dominance of the president's ethnic group, Chewa, Yao, and Lomwe, the cluster share of women over 35 who gave birth before turning 18, and grid-cell by year fixed effects. _part is a binary indicator for exposure during one to four years when age 12-16, _all is a binary indicator for exposure all five years when age 12-16. *** p<0.01, ** p<0.05, * p<0.1.

The estimated effects are seemingly driven by a reduction in births among girls in their later teens. In the Appendix (Table A7) we present results of estimations evaluating the impact of SRH-HIV and education projects on girls' childbearing before ages 15, 16, 17, 18 and 19, respectively. We observe negative treatment effects for births up to ages 17, 18 and 19, but not for births at age 16 and younger.

Allowing for exposure to multiple aid project simultaneously (Table A8) does not alter the key results but rather suggest sizeable joint effects of SRH-HIV and education aid. Including the SRH-HIV and education treatment variables simultaneously does not significantly alter their estimates. Neither does accounting for infrastructure aid or aid to the health sector more broadly. Results of an estimation exploring interaction effects between various degrees of exposure to SRH-HIV and education aid suggest that their combined effect can be sizeable. Full exposure to both SRH-HIV and education projects reduces teen childbearing by as much as 20 percentage points.

Furthermore, the results are robust to varying the age of exposure to aid projects between 8 and 17 years (Table A9), to accounting for possible contamination bias due to multiple treatments using the approach of Goldsmith-Pinkham et al. (2024) (Appendix D), and to using coarsened exact matching to ensure that treated and non-treated girls are balanced on key covariates (Appendix E).[13]

[13] It would be interesting to evaluate differences between donors. However, the data does not allow for such a detailed analysis. Table A10 lists the donors and the number of projects. A challenge is that they are few, of different sizes, and sometimes located in the same areas.

5.1 Mechanisms

To evaluate possible mechanisms, in Table 3 we present the results of estimations assessing the effects of SRH-HIV and education aid on factors known to matter for teenage fertility (Chintsanya, Magadi, and Likupe, 2021; Vaivada et al., 2022; ACERWC, 2022; Giacobino et al., 2024). The specifications and the samples vary depending on the variable of interest. For example, we use a sample of current teenagers when estimating the impact of exposure to aid projects on the use of contraceptives. Exposure is defined in the same way as in the main analysis, and we use the same control variables as before, except that the share of women age 35 and above who gave birth early in the cluster is replaced with a variable corresponding to the dependent variable in the estimation in question.

The results suggest that exposure to education aid increases the duration of schooling (Column 1) and delays marriage (Column 3) by around half a year. [14] In relation to the sample means of these variables, which are 7 years of schooling and an average marrying age of 17, these effect sizes are notable, and consistent with Zenebe Gebre (2020), who studied the introduction of free primary education in Malawi and found that it led to an additional 1.2 years of schooling and increased the age of first childbirth and marriage by nearly a year. Furthermore, SRH-HIV aid appears to increase the share of young women who have never been in a relationship by around 6-8 percentage points (Column 4), equivalent to between a quarter and a third of the sample mean, as well as the preferred waiting time between births by three to four months (Column 6). On the other hand, we observe no statistically significant effects of exposure to SRH-HIV and education aid on age at sexual debut (Column 2),[15] nor on the use of modern contraceptives among teenagers (Column 5), which is reportedly low overall (the sample mean is 12%).

Table 3. Estimated impact of aid exposure on potential mechanisms.

	(1) Education in years	(2) Age at first sex	(3) Age at first marriage	(4) Never in a relationship	(5) Modern contraceptives	(6) Preferred waiting time
Sample	Women 20-24	Women 20-24 who had sex	Married women age 20-24	Women 18-25	Girls age 15-19	Women age 18-24 who gave birth
EDU_part	0.550***	0.077	0.457***	-0.019	0.004	0.053
	(0.192)	(0.130)	(0.161)	(0.020)	(0.015)	(0.104)
EDU_all	0.427*	0.225	0.497***	0.031	0.018	0.162
	(0.240)	(0.154)	(0.185)	(0.032)	(0.020)	(0.138)

[14] Worth noting, however, the sample is potentially endogenous since not all women are married at the time of the survey. 19% of women in the original sample report to never have been married.

[15]. Note, however, that the sample is endogenous to ever having had sex 8.35% of the women in the original estimation sample reported never to have had sex.

SRH-HIV_part	0.230	-0.008	-0.062	0.055***	-0.005	0.062
	(0.159)	(0.105)	(0.131)	(0.019)	(0.011)	(0.083)
SRH-HIV_all	0.397	-0.003	-0.036	0.080***	0.013	0.323**
	(0.245)	(0.174)	(0.208)	(0.031)	(0.021)	(0.151)
Constant	6.011***	15.093***	16.839***	-0.087	0.527***	3.043***
	(0.197)	(0.463)	(0.463)	(0.060)	(0.049)	(0.107)
Sample mean	7.02	16.56	17.32	0.24	0.12	3.35
Observations	6,487	5,935	5,255	8,101	10,080	5,897
R-squared	0.291	0.097	0.101	0.185	0.120	0.055

Note. OLS models and linear probability models with robust standard errors clustered at the survey-year cluster level. The control variables are religion, ethnicity, birthyear, urban residence, ease of access to nearest clinic, clinic nearby-urban interaction term, dominance of president's ethnic group, Chewa, Yao, and Lomwe, and grid-cell by year fixed effects. The models for education, first sex, and first marriage include controls of the dependent variable among women above age 35 in the cluster. The model for never in a relationship includes a control for the average age at first marriage among women above age 35 in the cluster. *** p<0.01, ** p<0.05, * p<0.1.

5. Conclusion

Motivated by the high number of teenage mothers in low-income countries and the recent cuts in international aid funding, this study examines whether aid projects contribute to reduced teenage childbearing near project sites. We focus on Malawi, a country with one of the highest shares of teenage mothers, and for which we have access to geo-referenced data on aid projects from a broad range of donors. This allows us to geographically match data on 778 aid project sites with 6,445 women aged 20-24. To identify the effect of aid, we rely on spatial and temporal variation in aid project coverage, coupled with variation in birthyear of women. We use grid-cell-by-survey-year fixed effects to control for a wide range of factors related to the systematic variation in allocation of aid across space and time, and control for historical childbearing in the cluster and factors related to the allocation of aid projects.

Our findings demonstrate that aid for sexual and reproductive health, HIV and education significantly reduces the likelihood of teenage childbearing. Young women exposed to these types of aid were between 15% and 25% less likely to give birth as teenagers. Other types of aid do not seem to have an effect, but this could be due to data limitations. Among the mechanisms explored, the positive effects of aid seem primarily driven by girls increasing their time in school and delaying marriage and other relationships. We do not find any associations between aid and the age of first sex and the use of modern contraceptives.

Despite the robust findings, the study has some limitations. First, focusing on geocoded aid projects, we only capture aid projects with tangible project sites. The estimated effects should thus be interpreted as effects above and beyond the potential effects of aid distributed directly to the government or large geographic areas. Second, the analysis is limited to Malawi; and the

results may not be directly generalizable to other countries. Third, while we can establish that SRH-HIV and education aid projects have on average been effective in reducing teen childbearing, with the data at hand we are not able to tell what type of SRH-HIV and education aid projects have been more effective. Finally, while we explored several mechanisms, the complexity of factors affecting teenage childbearing means that other unobserved mechanisms may also play a role.

With these caveats in mind, the results are encouraging. In particular, the consistent finding that aid to sexual and reproductive health, HIV/AIDS and education helps reduce teenage childbearing highlights that available policy instruments can effectively influence a behavioral pattern with documented harmful consequences for the young mother, child and society at large. Importantly, however, this also means that recent reductions in international aid funding threaten the achievement of the Sustainable Development Goals, specifically Good Health and Well-being and Gender Equality, both of which target teenage fertility (Targets 3.7 and 5.6).

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Appendix

Appendix A

Table A1: Donor composition of project sites

Donor	Freq.	Percent	Cum.
African Development Bank (AfDB)	79	10.15	10.15
Arab Bank for Economic Development in..	8	1.03	11.18
Australian Agency for International D..	7	0.90	12.08
European Union (EU)	313	40.23	52.31
Flemish International Cooperation Agency	4	0.51	52.83
German Agency for International Cooperation	53	6.81	59.64
Icelandic International Development A..	6	0.77	60.41
International Fund for Agricultural D..	3	0.39	60.80
Irish Aid	11	1.41	62.21
Japan International Cooperation Agency	1	0.13	62.34
KFW Bankengruppe	2	0.26	62.60
Kuwait Fund	5	0.64	63.24
Norwegian Agency for Development Cooperation	117	15.04	78.28
OPEC Fund	8	1.03	79.31
People's Republic of China	1	0.13	79.43
UK Department for International Development	69	8.87	88.30
UNDP	2	0.26	88.56
UNHCR	2	0.26	88.82
US Agency for International Development	8	1.03	89.85
US Center for Disease Control and Prevention	12	1.54	91.39
World Bank	66	8.48	99.87
World Food Program (WFP)	1	0.13	100.00
Total	778	100.00	

Source: AidData, see Peratsakis, et al. (2012)

Table A2: Sectoral breakdown of aid projects

Sector	Freq.	Percent
Productive sectors		
Agriculture	65	8.35
Infrastructure	146	18.77
Tourism, Wildlife and Culture	4	0.51
Democratic Governance	19	2.44
Economic Governance	9	1.16
Environment, Lands and Natural Resources.	26	3.34
Social sectors		
Education	32	4.11
Health	148	19.02
Rural Development	248	31.88
Vulnerability, Disaster and Risk Management	10	1.29
Water, Sanitation, and Irrigation	52	6.68
Gender, Youth Development and Sports	19	2.44
Total	778	100.00

Source: AidData, see Peratsakis, et al. (2012)

Table A3. Reported age at first sex by women aged 21-29, both surveys

Age	Freq.	Percent	Cum.
8	35	0.15	0.15
9	15	0.07	0.22
10	111	0.49	0.71
11	160	0.71	1.42
12	704	3.11	4.53
13	1,062	4.69	9.22
14	2,216	9.79	19.01
15	3,906	17.25	36.26
16	3,344	14.77	51.03
17	3,197	14.12	65.16
18	3,384	14.95	80.1
19	1,817	8.03	88.13
20	1,387	6.13	94.26
21	585	2.58	96.84
22	339	1.5	98.34
23	197	0.87	99.21
24	96	0.42	99.63
25	51	0.23	99.86
26	21	0.09	99.95
27	7	0.03	99.98
28	4	0.02	100
Total	22,638	100	

Source: Malawi DHS 2000 and Malawi DHS 2015/16.

Table A4 : Description of variables

The main sample is women born between 1990 and 1995 who were over 19 years old at the time of the Malawi DHS 2010 and Malawi DHS 2015/16.

Outcome variables

Teenage births: Dummy variables indicating if a girl, 13 years or older, gave birth before the age of 17, 18, and 19 years or dummy variables indicating if a girl, 9 years or older, gave birth before turning 15 and 16 years.

Variables relating to treatment

Treated is a dummy indicating if a woman lived in a treated location, i.e., within 10 km of an active project. The primary period during which a girl is treated typically spans from 12 to 16 years.

Partially treated: denoted *x_part.* The location where the woman resided from 12 to 16 years old had a project for part of the five years.

Fully treated: denoted *x_all.* The treated location had a project for all five years.

Aid sectors

SRH-HIV: A measure of aid broadly targeted at teenagers' reproductive health, using DAC's purpose codes for "population policies" and "HIV/AIDS" within the health sector

EDU, Education

Health

Agriculture

Infrastructure

Rural Development

AID, All aid sectors

Individual control variables

Birth year: Dummies for birthyears.

Urban: Dummy variable=1 if the woman lives in an urban area; 0 otherwise.

Clinic nearby: Dummy variable=1 if the woman has self-reported easy access to a clinic, zero otherwise

Religious affiliation: Dummies for the religious affiliation of women (Catholic, CCAP, Anglican, Seventh Day Adventist/Baptist, "other Christian," Muslim, no religion, and "other," respectively).

Ethnic group: Dummies for the ethnic group (Chewa, Tumbuka, Lomwe, Tonga, Yao, Sena, Nkhonde, Ngoni, and 'other' category).

President's ethnic group: Chewa, Lomwe, or Yao. Dummies for clusters and periods where the president's ethnic group is over 75%.

Share early births. Cluster averages of women over 35 years who gave birth before the age of 18.

Year and spatial fixed effects

Grid-cell by year FEs: 272 grid cells (55*55 km) by survey year (2010, 2015, 2016) dummies.

Mediators

Years of education

Age of first sex

Age of marriage

Never in a relationship: The sample consists of women 18-25 years

Use of modern contraceptives: The sample consists of girls 15-19 years

Preferred waiting time: The time between the first and second births. The sample consists of women who have given birth once.

Note: The geocoded data on aid projects in Malawi is obtained from AidData (originally Peratsakis et al., 2012). The data on outcome and control variables is from the Malawi Demographic and Health Surveys.

Table A5. Aid project exposure

Variable	Obs	Mean	Std. Dev.	Min	Max
Major aid sectors					
SRH-HIV	6453	.234	.423	0	1
Education (EDU)	6453	.185	.388	0	1
Health	6453	.384	.486	0	1
Infrastructure	6453	.312	.463	0	1
Agriculture	6453	.210	.407	0	1
Rural	6453	.540	.498	0	1
All aid (AID)	6453	.742	.437	0	1
Intensity of treatment					
SRH-HIV_part_	6453	.149	.356	0	1
SRH-HIV_all_	6453	.085	.279	0	1
EDU_part	6453	.133	.340	0	1
EDU_all	6453	.052	.222	0	1
AID_part	6453	.239	.427	0	1
AID_all	6453	.503	.50	0	1
SRH-HIV and EDU combined					
SRH-HIV none EDU_none	6453	.703	.457	0	1
SRH-HIV_part EDU_none	6453	.095	.293	0	1
SRH-HIV none Edu_part	6453	.053	.225	0	1
SRH-HIV_part EDU_part	6453	.026	.158	0	1
SRH-HIV_all EDU_none	6453	.017	.130	0	1
SRH-HIV_all EDU_part	6453	.054	.226	0	1
SRH-HIV_none EDU_all	6453	.010	.099	0	1
SRH-HIV_part EDU_all	6453	.029	.166	0	1
SRH-HIV_all EDU_all	6453	.014	.117	0	1

Note: The table is based on women born 1990-1995 who were 20-24 years old at the time of the surveys. Part is a partially treated location during the exposure period, 12-16 years, and all is a location treated for all five years, 12-16.

Table A6. Testing the main aid sectors using the full sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age of exposure	12-16	12-16	12-16	12-16	12-16	12-16	12-16
Births at age	13-19	13-19	13-19	13-19	13-19	13-19	13-19
SRH-HIV	-0.066***						
	(0.020)						
EDU		-0.062**					
		(0.025)					
Health			-0.038**				
			(0.017)				
Infrastructure				-0.057***			
				(0.018)			
Agriculture					-0.023		
					(0.019)		
Rural						-0.019	
						(0.016)	
All aid							-0.031*
							(0.016)
Constant	0.642***	0.650***	0.648***	0.650***	0.642***	0.648***	0.660***
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.031)	(0.032)
Observations	6,445	6,445	6,445	6,445	6,445	6,445	6,445
R-squared	0.098	0.099	0.097	0.097	0.096	0.096	0.096

Note. Linear probability models with robust standard errors clustered at the survey-year cluster level. The dependent variable is teenage childbearing (age 13-19). All regressions control for birth year, religion, ethnicity, urban residence, ease of access to the nearest clinic, urban-clinic interaction term, dominance of the president's ethnic group, Chewa, Yao, and Lomwe, the cluster share of women over 35 who gave birth before turning 18, and grid-cell by year fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Table A7. Linear probability models of childbearing before different ages on family planning and HIV/AIDS aid (SRH-HIV) and education aid, using the full sample.

Panel A: Family planning and HIV/AIDS aid

	(1)	(2)	(3)	(4)	(5)
Age of exposure	8-15	8-15	12-16	12-16	12-16
Births at	9-15	9-16	13-17	13-18	13-19
SRH-HIV_part_8-15	-0.002	-0.014			
	(0.008)	(0.013)			
SRH-HIV_all 8-15	0.015	0.008			
	(0.024)	(0.035)			
SRH-HIV_part_12-16			-0.006	-0.012	-0.052**
			(0.018)	(0.020)	(0.021)
SRH-HIV_all_12-16			-0.056**	-0.075**	-0.108***
			(0.027)	(0.031)	(0.033)
Constant	0.089***	0.178***	0.331***	0.496***	0.643***
	(0.013)	(0.019)	(0.025)	(0.029)	(0.029)
Observations	10,160	9,039	8,083	7,252	6,445
R-squared	0.044	0.060	0.064	0.081	0.098

Panel B: Education aid

	(1)	(2)	(3)	(4)	(5)
Age of exposure	8-15	8-15	12-16	12-16	12-16
Births at	9-15	9-16	13-17	13-18	13-19
EDU_part_11-15	-0.010	-0.017*			
	(0.007)	(0.010)			
EDU_ all_11-15	-0.022*	-0.030			
	(0.013)	(0.023)			
EDU_part_12-16			-0.032	-0.035	-0.063**
			(0.020)	(0.023)	(0.026)
EDU_all_12-16			-0.080***	-0.089***	-0.098***
			(0.028)	(0.034)	(0.038)
Constant	0.091***	0.182***	0.334***	0.499***	0.650***
	(0.014)	(0.019)	(0.025)	(0.029)	(0.030)
Observations	10,160	9,039	8,083	7,252	6,445
R-squared	0.044	0.060	0.064	0.081	0.098

Note. Linear probability models with robust standard errors clustered at the survey-year cluster level. The dependent variable is teenage childbearing in the specified age spans. Exposure is meased between ages 8-15 in columns 1-2, and between ages 12-16 in column 3-5. The age at first birth is 9 in columns 1-2. _part is a binary indicator for exposure during one to four years in the concerned age span, _all is a binary indicator for exposure all years in the concerned age span. All regressions control for birth year, religion, ethnicity, urban residence, ease of access to a health clinic, urban-clinic nearby interaction term, dominance of the president's ethnic group, Chewa, Yao, and Lomwe, the cluster share of women over 35 who gave birth before turning 18, and grid-cell by year fixed effects. *** p<0.01, ** p<0.05, * p<0.1.

Table A8. Linear probability models of teenage childbearing on family planning-, education-, health-, infrastructure-and combinations of family planning- and education aid.

	(1)	(2)	(3)	(4)
Age of exposure	12-16	12-16	12-16	12-16
Births at	13-19	13-19	13-19	13-19
SRH-HIV_part	-0.039*	-0.029	-0.039*	
	(0.021)	(0.023)	(0.021)	
SRH-HIV_all	-0.087***	-0.077**	-0.087***	
	(0.033)	(0.034)	(0.033)	
EDU_part	-0.043*	-0.043		
	(0.026)	(0.026)		
EDU_all	-0.075**	-0.077**		
	(0.037)	(0.038)		
INF_part		-0.046*		
		(0.025)		
INF_all		-0.024		
		(0.023)		
HEALTH_part			-0.008	
			(0.020)	
HEALTH_all			-0.028	
			(0.031)	
SRH-HIV_part EDU_none				-0.039*
				(0.023)
SRH-HIV_none EDU_part				-0.051*
				(0.031)
SRH-HIV_part EDU_part				-0.064
				(0.045)
SRH-HIV_all EDU_none				-0.045
				(0.050)
Pop full EDU_part				-0.135***
				(0.041)
SRH-HIV_none EDU_all				0.046
				(0.060)
SRH-HIV_part EDU_all				-0.137***
				(0.050)
SRH-HIV_all EDU_all				-0.214***
				(0.055)
Constant	0.650***	0.655***	0.644***	0.649***
	(0.030)	(0.030)	(0.030)	(0.030)
Mean dep. variable	0.620	0.620	0.620	0.620
Observations	6,445	6,445	6,487	6,487
R-squared	0.099	0.100	0.098	0.100

Note. Linear probability models with robust standard errors clustered at the survey-year cluster level. The dependent variable is teenage childbearing (age 13-19). All regressions control for birth year, religion, ethnicity, urban residence, ease of access to the nearest clinic, urban-clinic interaction term, dominance of the president's ethnic group, Chewa, Yao, and Lomwe, the cluster share of women over 35 who gave birth before turning 18, and grid-cell by year fixed effects. _part is a binary indicator for exposure during one to four years when age 12-16, _all is a binary indicator for exposure all five years when age 12-16; *** p<0.01, ** p<0.05, * p<0.1

Table A9. Checking exposure at the ages 8-16, 11-16, and 12-17. Linear probability regressions of teenage childbearing on family planning and educational aid. Women born between 1990 and 1995 using the full sample.

	(1)	(2)	(3)	(4)	(5)	(6)
Age of exposure	8-16	11-16	12-17	8-16	11-16	12-17
Births at age	13-19	13-19	13-19	13-19	13-19	13-19
SRH-HIV_8-16	-0.067***					
	(0.020)					
SRH-HIV_11-16		-0.062***				
		(0.020)				
SRH-HIV_12-17			-0.058***			
			(0.020)			
EDU_8-16				-0.031**		
				(0.015)		
EDU_11-16					-0.030**	
					(0.015)	
EDU_12-17						-0.074***
						(0.025)
Constant	0.641***	0.646***	0.646***	0.648***	0.648***	0.652***
	(0.029)	(0.029)	(0.030)	(0.030)	(0.030)	(0.030)
Observations	6,487	6,485	6,445	6,487	6,485	6,445
R-squared	0.098	0.098	0.097	0.097	0.097	0.098

Note: See Table A6. SRH-HIV_8-16 shows exposure at the age between 8 and 16 years, and so on.

Table A10. Donors and family planning and education projects

Family planning	Freq.
Norwegian Agency for Development Cooperation	10
UK Department for International Development.	31
US Agency for International Development	4
US Center for Disease Control and Prevention	12
Sum	57
Education	
African Development Bank (AfDB)	14
German Agency for International Cooperation	6
Icelandic International Development Agency	1
Irish Aid	1
Japan	1
UK Department for International Development	1
US Agency for International Development	2
World Bank	8
Sum	34

Appendix B: Geocoded aid projects

The aid data contains project coordinates (latitude and longitude) and provides information about the precision of the identified location (AidData Research and Evaluation Unit, 2017). Following Strandow et al. (2011), these precision codes range from 1, indicating the most precise location, to 8, indicating the least precise location. Precision category 1 refers to 'an exact location, such as a populated place or a hill', category 2 to being 'near', in the 'area' of, or up to 25 km away from an exact location, category 3 refers to the second order administrative division in a country, such as a district, and category 4 to the first order administrative division, such as a province. Precision category 5 refers to the estimated coordinates of large features that potentially span several ADM1s, such as rivers and national parks. Categories 6-8 are used for projects lacking a clear sub-national destination, e.g., flows going to the central government.

Being interested in the local effects of aid projects, we focus on projects in precision category 1and 2. After initial sample restrictions (focusing on projects with necessary information on start and end dates), this applies to 49 percent of project sites (778 out of 1589). Here, a few notes are in order.

To begin with, it is worth emphasizing that we consider a subset of aid projects rather than the full universe of aid and that aid projects with precise geocodes do not constitute a representative sub-sample of all aid projects in a country. To geocode an aid project meaningfully, it must have a physical project site. While some projects are implemented in a well-defined geographical area, others are realized at more aggregate levels, such as districts or larger administrative regions, or do not have a physical project site (for example, budget- and sector-based support). We thus restrict our attention to projects with tangible project sites. Examining Tables B1 and B2, which compare the precisely geocoded sample projects and imprecisely geocoded omitted projects in terms of sector and donor composition, we can, for instance, observe that we capture a majority of health projects but only a minority of education projects

Furthermore, projects without precise geocodes not captured by our treatment variable may nonetheless influence teenage childbearing. While it is unfortunate to have to drop these, we cannot define treatment at the district level. Considering the density of aid projects in Malawi, this would result in essentially all girls being treated. If girls who are not treated according to our local aid exposure indicator experience some benefits of aid projects realized at more aggregate levels, this will contaminate our control group and attenuate our estimated treatment

effects. Interpreting our findings, one should keep in mind that our treatment variable captures variation in local aid exposure that exists beyond aid coverage at more aggregate levels.

Finally, even if we focus on aid projects with relatively precise geo-codes, one may be worried by the imprecise geocodes in precision category 2, where the recorded location is described as 'near', in the 'area' of, or up to 25 km away from an exact location. While 25 km is the maximum (rather than the average) geo-locating error allowed here, the projects in this category are likely to introduce some noise in our treatment variable, especially considering that we define girls as treated if they were exposed to aid projects within a 10 km cut-off. This would again lead to attenuation bias. Reassuringly, the geo-codes of most of our sample project sites (669 out of 778) fall into precision category 1, and the results remain stable when using different distance cut-offs to define treatment (see Appendix C).

Table B1: Sectoral composition of precisely geocoded sample projects and imprecisely geocoded omitted projects

	Sample projects (geocoded with precision 1-2)		Omitted projects (geocoded with precision >=3)	
Sector	Freq.	Percent	Freq.	Percent
Agriculture	65	8.35	229	28.24
Democratic Governance	19	2.44	36	4.44
Economic Governance	9	1.16	5	0.62
Education	32	4.11	83	10.23
Environment, Lands, Natural Res.	26	3.34	61	7.52
Gender, Youth Dev. and Sports	19	2.44	41	5.06
Health	148	19.02	104	12.82
Integrated Rural Development	248	31.88	68	8.38
Roads, Public Works, Transport	146	18.77	52	6.41
Tourism, Wildlife and Culture	4	0.51	3	0.37
Trade, Industry, Private Sector	0	0	6	0.74
Vulnerability, Disaster, Risk	10	1.29	50	6.17
Water, Sanitation, Irrigation	52	6.68	73	9.00
Total	778	100.00	811	100.00

Table B2: Donor composition of precisely geocoded sample projects and imprecisely geocoded omitted projects

	Sample projects (geocoded with precision 1-2)		Omitted projects (geocoded with precision >=3)	
Donor	Freq.	Percent	Freq.	Percent
African Development Bank (AfDB)	79	10.15	116	14.30
Arab Bank for Economic Dev.	8	1.03	8	0.99
Australian Agency for Int. Dev.	7	0.90	7	0.86
European Union (EU)	313	40.23	93	11.47
Flemish Int. Cooperation Agency	4	0.51	8	0.99
Food and Agric. Org. (FAO)	0	0	62	7.64
German Agency for Int. Cooperation	53	6.81	22	2.71
Icelandic Int. Dev. Agency	6	0.77	1	0.12
International Fund for Agric. Dev.	3	0.39	27	3.33
Irish Aid	11	1.41	11	1.36
Japan	0	0	2	0.25
Japan Int. Cooperation Agency	1	0.13	5	0.62
KFW Bankengruppe	2	0.26	3	0.37
Kuwait Fund	5	0.64	3	0.37
Norwegian Agency for Dev. Coop.	117	15.04	158	19.48
OPEC Fund	8	1.03	6	0.74
People's Republic of China	1	0.13	0	0
UK Department for Int. Dev.	69	8.87	15	1.85
UNDP	2	0.26	51	6.29
UNHCR	2	0.26	3	0.37
UNIDO	0	0	8	0.99
US Agency for Int. Dev.	8	1.03	105	12.95
US Center for Disease Contr.	12	1.54	20	2.47
World Bank	66	8.48	33	4.07
World Food Program (WFP)	1	0.13	44	5.43
Total	778	100.00	811	100.00

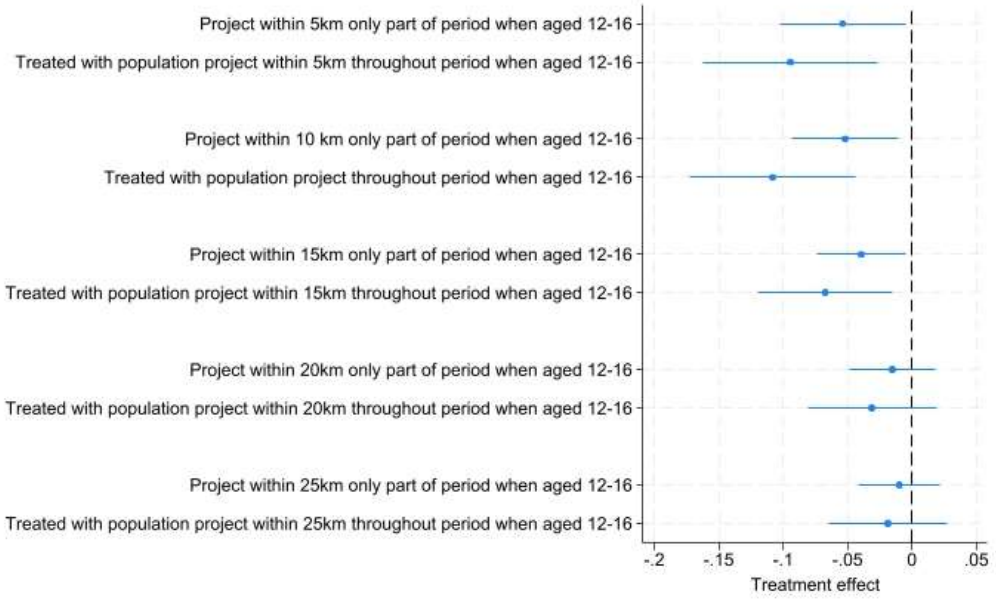
Appendix C: Using different distance cut-offs to define treatment

In the benchmark setup, we define girls as treated if they were exposed to aid projects within 10 km while aged 12-16. The 10 km cut-off is admittedly somewhat arbitrary. The geographical reach of aid project benefits should reasonably vary widely across different types of aid projects. Hence, a 10 km cut-off will be too wide for some projects (e.g., a highly targeted intervention in a specific community) and too narrow for others (e.g., an infrastructure project with significant positive spillovers for local economic activity). Since our data comprises 778 aid project sites, which cover aid projects that differ widely in terms of objectives and target beneficiaries, we cannot establish a general rule on geographic reach and use this to inform our baseline cut-off. Instead, we evaluate the sensitivity of results using different distance cut-offs.

Figure C1-C3 summarizes the results of estimations using distance cut-offs between 5 and 25 km to define treatment for family policy, education, and all aid, based on the full sample. The results display a similar pattern when using a 5–15 km cut-off for family planning, with smaller and statistically insignificant effect for a 20-25 km cut-off. For education projects, the effect of full exposure is always statistically significant, but the point estimate decreases as the distance of the cut-off increases. The effect of partial exposure is largest and statistically significant for the 10-20 km cut-offs, but not statistically significant for the 5 and the 25 km cut-off.

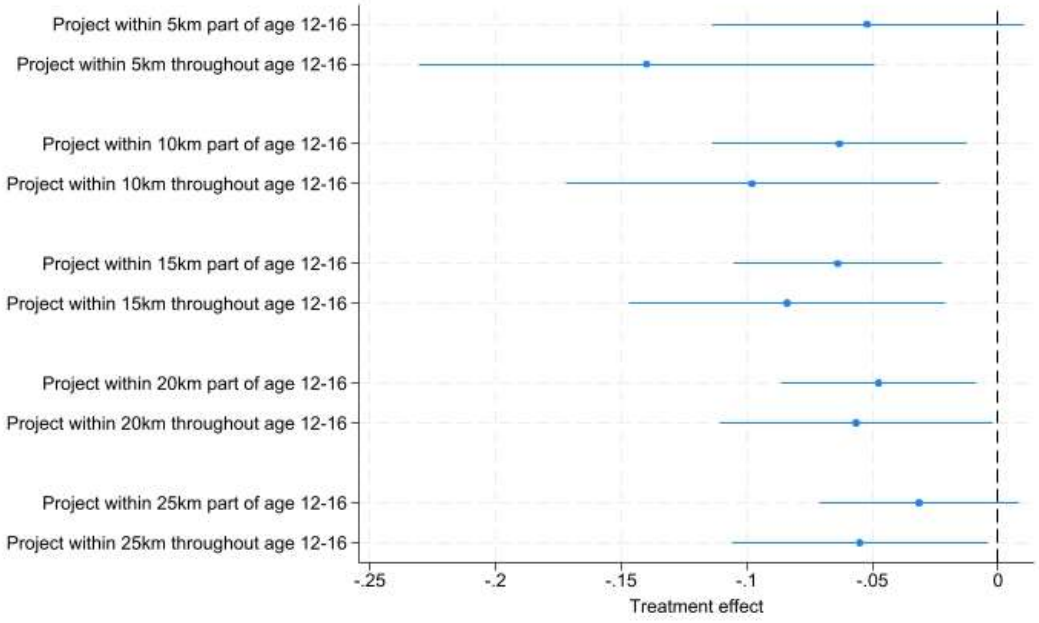
Table C1 gives the share of treated girls using different distance cut-offs. This share increases sharply with the bandwidth – from 17 percent when using a 5 km cut-off to 52 percent when using a 25 km cut-off for family planning, and from 46 percent to 96 percent for any aid project – highlighting the density of projects in Malawi.

Figure C1: Estimated effects of family planning projects on teenage childbearing using different geographical cutoffs to define treatment



Notes: Point estimates with 95% confidence intervals; treatment effects obtained from estimations, equivalent to those in Table 5, but varying the geographical cut-off used to define treatment. Treatment refers to the girls having had an active project within X km when they were 12 to 16 years old.

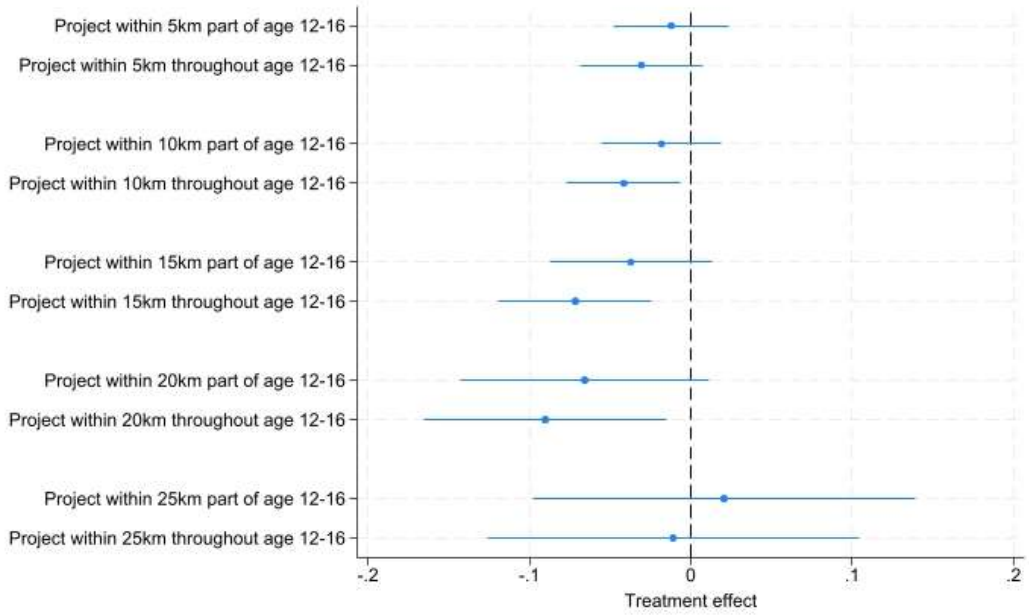
Figure C2: Estimated effects of education projects on teenage childbearing using different geographical cutoffs to define treatment



Notes: See Figure C1.

Figure C3: Estimated effects of all aid on teenage childbearing using different geographical cutoffs to define

treatment



Notes: See Figure C1

Table C1: Share treated when using different geographical cut-offs

Exposed girls	Obs	Share
Girls exposed to family planning projects within 5 km	6453	.169
Girls exposed to family planning projects within 10 km	6453	.234
Girls exposed to family planning projects within 15 km	6453	.336
Girls exposed to family planning projects within 20 km	6453	.424
Girls exposed to family planning projects within 25 km	6453	.521
Girls exposed to educational projects within 5 km	6453	.115
Girls exposed to educational projects within 10 km	6453	.185
Girls exposed to educational projects within 15 km	6453	.255
Girls exposed to educational projects within 20 km	6453	.332
Girls exposed to educational projects within 25 km	6453	.422
Girls exposed to any project within 5 km	6453	.458
Girls exposed to any project within 10 km	6453	.742
Girls exposed to any project within 15 km	6453	.893
Girls exposed to any project within 20 km	6453	.950
Girls exposed to any project within 25 km	6453	.964

Appendix D: Contamination bias

One concern is that some of our models have more than one treatment variable. According to Goldsmith-Pinkham et al. (2024), regressions with more than one treatment may fail to estimate convex averages of heterogeneous treatment effects when using observable data. The reason is that non-convex averages of the effects of other treatments contaminate estimates of each treatment's effect. Thus, we use the program Multe in Stata to evaluate if our findings suffer from such treatment bias (Kolesár, 2024). The program estimates five models that give the following estimates: The first, denoted *beta* gives the benchmark estimates and is similar to the ones reported in Table 5 and 7. It is a partially linear model estimated using weighted least squares. The second model, OWN, is based on weighted least squares regressions for each treatment, and weights computed using the treatment indicator variables and the controls and their interactions with the treatments. The third model is the ATE, the unweighted average treatment effect, which is implemented using regressions that include interactions of covariates with the treatment indicators. The third one is EW, a weighted ATE estimator based on the easiest-to-estimate weighting (EW) scheme, which is implemented by running one-treatment-at-a-time regressions. The final model is CW, a weighted ATE estimator using easiest-to-estimate common weighting (CW) scheme, implemented using weighted regressions. Note that OWN and ATE require common support, which is to say, overlap.

Tables D1-D3 report the results of SRH-HIV and education aid using the full sample and the same control variables as in Table A5. The benchmark estimates, *beta,* are similar to the OWN, ATE and EW estimates in Tables D1 and D2, and all the tests of differences between them are insignificant. There are, however, some significant differences between the *beta* and the CW estimates, particularly for education aid, where the CW estimates are clearly larger in absolute values (Table D2). The reason for the differences is probably that CW imposes common weighting across treatments, while EW and OWN target treatment-specific averages. Although CW, in principle is more efficient, it is more demanding, requiring similar overlap between the treatment groups, which does not seem to hold. In Appendix E we use coarsened matching to show that our results hold even with a much smaller matched sample. In line with the larger CW estimate, the estimates based on this matched sample are also substantially larger than the main estimates.

There is somewhat more variation across the estimates in Table D3, which reports models with SRH-HIV and educational aid combined. This probably is due to the small number of observations in some combinations. Yet, overall, all models provide the same message and only

three of the 48 tests of differences between our benchmark estimates and the others are significant. Thus, we conclude that there seems to be little bias contamination.

Table D1: Evaluation of bias contamination. Family planning and HIV/AIDS. The coefficients denoted beta are estimates of the linear probability models.

	Full sample			Overlap sample				
A: Estimates	beta	EW	CW	beta	OWN	ATE	EW	CW
Partially	-0.049**	-0.047**	-0.103***	-0.048**	-0.042**	-0.061**	-0.043**	-0.029
	(0.020)	(0.020)	(0.011)	(0.020)	(0.020)	(0.024)	(0.020	0.026
Fully	-0.092***	-0.085**	-0.136***	-0.086***	-0.080**	-0.091*	-0.082**	-0.058
	(0.033)	0.036	0.011	0.031	0.032	0.049	0.033	0.037
B: Bias								
Over half of time		-0.003	0.053**		-0.006	0.014	-0.004	-0.019
		0.005	0.020		0.005	0.018	0.005	0.018
Fully		-0.007	0.045		-0.005	0.006	-0.003	-0.027
		0.012	0.032		0.010	0.042	0.010	0.023

Note. Linear probability and partly linear models with robust standard errors clustered at the survey-year cluster level in parentheses. Robust standard errors under the estimates. The dependent variable is teenage childbearing. All regressions control for birth year, religion, ethnicity, urban residence, ease of access to the nearest clinic, urban-clinic interaction term, dominance of the president's ethnic group, Chewa, Yao, and Lome, the cluster share of women over 35 who gave birth before turning 18, and grid-cell by year fixed effects. *** p<0.01, ** p<0.05, * p<0.1.

Table D2: Evaluation of bias contamination. Educational aid. The coefficients beta are estimates of the linear probability models.

	Full sample			Overlap sample				
A: Estimates	beta	EW	CW	beta	OWN	ATE	EW	CW
Partially	-0.063**	-0.068***	-0.109***	-0.070***	-0.072***	-0.112***	-0.073***	-0.039
	0.025	0.025	0.009	0.023	0.023	0.026	0.023	0.033
Fully	-0.097***	-0.082**	-0.229***	-0.108***	-0.093***	-0.079***	-0.089***	-0.060
	0.037	0.038	0.009	0.035	0.035	0.091	0.036	0.046
B: Bias								
Partially		0.005	0.046*		0.002	0.042	0.003	-0.031
		0.006	0.025		0.004	0.020	0.004	0.024
Fully		-0.015	0.131***		-0.014	-0.029	-0.019	-0.048
		0.011	0.037		0.010	0.086	0.011	0.030

Note. See Table D1

Table D3: Evaluation of bias contamination. Family planning, HIV/AIDS and educational aid combined. The coefficients beta are estimates of the linear probability models.

	Full sample			Overlap sample				
A: Estimates	beta	EW	CW	beta	OWN	ATE	EW	CW
SRH-HIV_part								
EDU_none	-0.038*	-0.028	-0.068***	-0.056***	-0.055**	-0.054**	-0.053**	-0.055
	0.023	0.023	0.011	0.021	0.022	0.021	0.022	0.035
SRH-HIV_none								
EDU_part	-0.050	-0.057*	-0.072***	-0.039	-0.038	-0.031	-0.037	-0.038
	0.031	0.032	0.011	0.029	0.030	0.034	0.030	0.048
SRH-HIV_part								
EDU_part	-0.064	-0.060	-0.094***	-0.104***	-0.106**	-0.076	-0.107***	0.026
	0.045	0.050	0.011	0.037	0.041	0.051	0.041	0.073
SRH-HIV_all								
EDU_none	-0.044	-0.015	0.000	-0.064	-0.064	-0.039	-0.061	-0.102
	0.049	0.054	0.011	0.048	0.051	0.045	0.051	0.066
Pop full EDU_part	-0.132***	-0.143***	-0.300***	-0.119***	-0.130***	-0.151***	-0.136***	-0.127***
	0.040	0.044	0.012	0.036	0.040	0.052	0.039	0.049

SRH-HIV_none								
EDU_all	0.048	0.033	0.181***	0.023	0.024	0.071	0.026	-0.132
	0.060	0.064	0.010	0.058	0.057	0.050	0.056	0.109
SRH-HIV_part								
EDU_all	-0.135***	-0.106**	-0.190***	-0.156***	-0.161***	-0.227***	-0.166***	-0.192***
	0.050	0.051	0.010	0.043	0.045	0.048	0.045	0.054
SRH-HIV_all EDU_all	-0.216***	-0.238***	-0.026**	-0.219***	-0.236***	-0.665***	-0.238***	-0.330**
	0.056	0.065	0.011	0.050	0.057	0.074	0.056	0.164
B: Bias								
SRH-HIV_part								
EDU_none		-0.010	0.030		-0.001	-0.002	-0.002	0.000
		0.007	0.022		0.007	0.011	0.006	0.028
SRH-HIV_none								
EDU_part		0.007	0.022		-0.001	-0.009	-0.002	-0.001
		0.012	0.030		0.008	0.025	0.007	0.038
SRH-HIV_part								
EDU_part		-0.004	0.030		0.002	-0.028	0.003	-0.130
		0.025	0.045		0.014	0.042	0.014	0.063
SRH-HIV_all								
EDU_none		-0.029	-0.044		0.000	-0.024	-0.002	0.038
		0.023	0.049		0.013	0.047	0.013	0.058
Pop full EDU_part		0.011	0.168**		0.011	0.032	0.017	0.008
		0.022	0.041		0.018	0.048	0.017	0.028
SRH-HIV_none								
EDU_all		0.015	-0.133		-0.001	-0.048	-0.003	0.155
		0.016	0.060		0.006	0.055	0.006	0.118
SRH-HIV_part								
EDU_all		-0.029	0.054		0.006	0.071*	0.011	0.037
		0.022	0.050		0.011	0.037	0.012	0.045
SRH-HIV_all EDU_all		0.022	-0.190		0.017	0.446***	0.019	0.111
		0.036	0.056		0.030	0.078	0.027	0.145

Note. See Table D1.

Appendix E: Coarsened exact matching

The primary goal of matching is to create a treated and control group that are balanced with regard to key characteristics. We use coarsened exact matching (CEM) to remove observations that are dissimilar to observations with opposite treatment status from the sample, leaving a more balanced sample. CEM is similar to exact matching, but it coarsens variables that are continuous or with many categories into substantively meaningful groups temporarily, then use exact matching on these coarsened data. Finally, the analysis is run on the original un-coarsened data for the matched sample (Iacus et al., 2012). The approach has the advantage of making the potential lack of common support, or overlap, in covariates between the treatment and control groups explicit. Using matching, we thus avoid drawing conclusions based on extrapolations.

We match exactly on grid cells, religion, ethnicity, birth year, urban, nearby clinic, nearby clinic-urban, and dummies for the presidents' ethnic group. We coarsen on interview year by survey and share of teenage pregnancies among women over 35 in the area. While the resulting matched sample is significantly smaller than the original sample, the treatment effects remain qualitatively similar (see Table E1).

Table E1: Coarsened exact matching (CEM).

	(1)	(2)	(3)
SRH-HIV_12_16	-0.137***		
	(0.047)		
EDU_12-16		-0.103*	
		(0.053)	
AID_12-16			-0.057*
			(0.031)
Constant	0.740***	0.697***	0.690***
	(0.128)	(0.096)	(0.062)
Observations	486	477	1,054
R-squared	0.033	0.024	0.023

Notes: Treatment: having an active project within 10 km while aged 12-16. We match exactly on grid cells, religion, ethnicity, birthyear, urban, nearby clinic, nearby clinic-urban, dummies for the presidents' ethnic groups: Lomwe, Chewa and Yao, and coarsened on interview year by survey wave and share early births. The estimations are based on the matched observations and additionally control for interview year dummies and share of early births. Robust standard errors clustered at the survey-year cluster level. *** p<0.01, ** p<0.05, * p<0.1.

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