Impacts of two-year multi-sectoral interventions on young adolescent girls’ education, health and economic outcomes: Adolescent Girls Initiative-Kenya randomized trial

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Abstract

Background

Early adolescence is a critical window for intervention when it is possible to lay a foundation for a safe transition to adulthood, before negative outcomes occur. The Adolescent Girls Initiative–Kenya randomized trial tested the effects of combinations of interventions for young adolescent girls in two sites – the Kibera informal settlement in Nairobi and rural Wajir County in the Northeastern region.

Methods

The interventions included community dialogues on the role and value of girls (violence prevention), a conditional cash transfer (education), weekly group meetings for girls with health and life skills training (health), and training and incentives for financial literacy and savings activities (wealth creation). Participants were randomized to one of four study arms: 1) violence prevention only, 2) violence prevention and education, 3) violence prevention, education and health or 4) violence prevention, education, health and wealth creation. An intent-to-treat (ITT) analysis was conducted to estimate the impact of each combination of interventions and various sensitivity analyses conducted addressing potential attrition bias and multiple hypothesis testing concerns.

Results

In Kibera, the conditional cash transfer had small effects on grade attainment but larger impacts on completion of primary school and the transition to secondary school in the most comprehensive arm; the health intervention improved sexual and reproductive health knowledge and condom self-efficacy; and the wealth intervention improved financial literacy and savings behavior. In Wajir, the conditional cash transfer increased school enrollment and grade attainment, and the wealth intervention improved savings behavior.

Conclusions

The results indicate that when trying to improve a range of outcomes related to adolescent wellbeing for young girls, a multi-sectoral intervention with components addressing household economic constraints is a promising approach.

Introduction

Over the past decade there has been an increasing focus on investment and programming for adolescents, in particular girls [1–4]. Interventions designed for adolescent girls have potential for triple benefit—in their current lives, in their future lives and in the lives of their children [5]. Focus on young
adolescent girls ages 10–14 can be particularly effective as that period of life is a critical window of opportunity prior to negative outcomes occurring, and thus laying a foundation for a healthy future in later adolescence and early adulthood [6–8].

Because they are both female and children, adolescent girls face intersecting vulnerabilities, with those living in marginalized or impoverished settings at even greater risk [2]. Among adolescents ages 15–19, girls account for over two-thirds of worldwide new HIV infections [9] and 11% of all births are to girls in this age range, with 95% of those births in low and middle income countries [10]. This is even more concerning since complications during pregnancy and childbirth are leading causes of death for females ages 15–24 years [11]. Although such outcomes are directly related to health, they are also strongly associated with social factors including inequitable gender norms, unequal access to education—notably secondary school—and early marriage.

Adolescent girls in both urban and rural Kenya face these and similar risks, although the underlying causes and possible remedies may be different across those types of areas. Forty-three percent of girls ages 15–19 living in urban informal settlements are not in school [12] and schooling is even lower outside urban areas; for example, 25% of young adolescent girls in northeastern Kenya have never been to school [13]. Nine percent of girls in Kenyan urban informal settlements ages 15–17 and 45% of girls 18–20 have given birth [14]; 50% of girls in northeastern areas of Kenya are married by the age of 18 [12]. Poor education, health and demographic outcomes are exacerbated by inequitable gender norms and attitudes among adolescents, with over half of very young adolescent girls indicating acceptability of intimate partner violence, similar to rates observed for adult women [12].

In addition to the individual level, factors at the household and community levels also influence adolescent girls’ health outcomes. Therefore, some recommend a socioecological approach for designing effective programs [8, 15]. The socioecological model for adolescent health places individual health, education, self-efficacy and safety at the center, while also incorporating the role of the school, family and neighborhood. Programs that operate only at the individual level may not be sufficient to yield long-term benefits in education or fertility outcomes, as evidenced by a recent female empowerment program for vulnerable adolescent girls in Zambia [16].

Relatedly, research also suggests a multi-sectoral approach—simultaneously addressing education, health and economic constraints—is likely to result in a wider range and longer-lasting set of beneficial outcomes. Substantial literature demonstrates the multiple benefits of educating girls, including improved reproductive health, delayed marriage, lower total fertility rates and improved health for both the girls and their children, as well as economic benefits for the woman as an adult, her family and her community [17–20]. Evidence exists that shows economic assets have benefits in other areas of girls’ and women’s lives beyond standard poverty indicators. Girls in Malawi who received cash transfers for schooling were less likely to marry early, report sexual activity or have a teenage pregnancy [21]. A lack of economic resources has also been identified as a barrier to safer sex practices and a factor associated with increased transactional sex for adolescent girls [22–24]. For example, girls who have fewer economic
assets are more likely to have exchanged sex for money, gifts or shelter [25]. Economic interventions on their own, however, may not improve health outcomes and can even increase risk among adolescents [26, 27], whereas programs that combine economic strengthening interventions with prevention of violence and health promotion components have had beneficial effects in all three areas [28], although there may be tradeoffs to consider if they increase costs or if implementation quality is reduced in more complex multi-component interventions.

Given the role of poverty in development, cash transfers, both conditional and unconditional, have also become a central component in a wide range of program interventions. It has been established that household cash transfers can have benefits for adolescents, including reducing child labor [29], improving educational outcomes [30–33] and lowering the odds of sexual activity [34], pregnancy [35] and other risky sexual behaviors [36–38]. However, whether cash transfers on their own can have transformative effects is less clear [39, 40], especially because evidence has emerged that cash alone can fall short in promoting longer-term, secondary outcomes such as improved learning outcomes or reduced morbidity [41, 42]. This has led to consideration of “cash plus” programming, building on the hypothesis that cash transfers, combined with additional program components or linkages to external services, may be more effective than cash alone in achieving desired, sustained effects [43]. While such combined social protection has been shown to lead to larger reductions in HIV risk for adolescent girls in South Africa [44], and there is qualitative evidence of increased effectiveness from a program combining cash transfers and financial education for out of school adolescent girls in rural Tanzania [45], research comparing cash alone to cash plus programming for similar population remains limited.

The Adolescent Girls Initiative-Kenya (AGI-K) is a randomized trial designed to test the short-term (after two years) and longer-term effects of two-year, multi-level, multi-sectoral interventions for young adolescent girls ages 11–14 in two distinct marginalized areas of Kenya. The principal short-term hypotheses analyzed in this paper at the end of the two-year intervention in each study site are whether: 1) the specific intervention combinations affected the outcomes; 2) the more sectors covered by the program, the wider the range of outcomes influenced; and 3) compared to a conditional cash transfer (CCT) for schooling, intervention packages that combine a CCT for schooling with health and financial education components, or “cash plus,” result in larger effects not only on the targeted health and financial-related outcomes specific to those interventions but also on other outcomes such as schooling, as a result of synergies between the interventions. We report results for the two sites together to allow for comparisons of their effectiveness in the two different contexts.

Methods

Intervention Context

AGI-K was implemented in two distinct sites: 1) the urban informal settlement of Kibera in Nairobi; and 2) rural Wajir County on the northeastern border of Kenya with Somalia. Kibera is characterized by high population density (more than 20,000 people per square kilometer) with substantial residential mobility,
and has poor-quality housing, high crime rates, minimal government services, and multiple religious and ethnic groups. In 2006, 60% of adolescent girls ages 10–19 in Kibera felt there was a lot of crime in their neighborhood and at times feared they would be sexually assaulted [46]. Less than half of adolescent girls ages 18–19 had attended secondary school and 28% of unmarried sexually active girls had given birth [46]. Median age at marriage was 22 [12]. The AGI-K study sample from Kibera exhibits similar characteristics and deprivations to other urban settings in Kenya [13]. Kibera is the largest informal settlement in Kenya, and its residents live in conditions similar to those of more than half the greater Nairobi population, and more than 55 million Africans living in urban areas elsewhere on the continent [47]. Wajir County is a semi-arid rural area characterized by low population density (less than 20 people per square kilometer), dispersed communities, minimal infrastructure, and a predominant religious and ethnic group, Muslim Somalis [48]. More than three-quarters of women ages 15–49 in Wajir have never attended school so that only 21% were literate, the median age at first marriage was 18, and the total fertility rate is 7.8—the highest in Kenya [12]. Wajir County is a similar context in both culture and geography to other counties in northeastern Kenya, as well as many other semi-arid regions throughout the Horn of Africa, although it is not representative of crop agriculture-based rural areas in other parts of Kenya or the region.

Theory of Change

Figure 1 presents the theory of change underpinning AGI-K [49]. It outlines how interventions in the violence prevention and education sectors targeting the community and household are combined with interventions in the education, health and wealth creation sectors targeting the individual girls. Together, the interventions are designed to empower the girls, improving their “ability to formulate strategic choices, and to control resources and decisions that affect important life outcomes” [50]. We hypothesize the interventions had effects on household norms, household economic assets and female adolescent educational, health, social and economic assets.

Important in their own right, the potential effects are also key mediating factors for the primary objective of AGI-K, delayed childbearing. Given the substantial differences across the two sites, effects of the interventions on the mediating factors and the pathways from those factors to delayed childbearing in each setting also likely differ. For example, because initial schooling attainment was dramatically different in the two settings, impacts on education, as well as how it subsequently influences childbearing, likely differ. Norms regarding sex and marriage also differed substantially across the settings, with premarital sex common in Kibera but not Wajir. Therefore, delayed childbearing is hypothesized to result from delayed sexual debut and increased contraceptive use in Kibera, but from delayed marriage in Wajir. This paper assesses the impact just after the completion of the two-year AGI-K interventions on the mediating factors, when girls were between 13–16 years old. Arguably, impacts on some or all those factors are necessary for subsequent delayed childbearing, the longer-term primary objective to be examined when the girls are older in an endline survey two years after the end of the interventions (and thus four years after the start of the interventions) when girls would be between 15–18 years old.
Interventions

The AGI-K intervention packages included nested combinations of four single-sector interventions—violence prevention, education, health and wealth creation—implemented for two years from August 2015 through July 2017. The Population Council Kenya oversaw the programs which were implemented by the non-governmental organizations (NGOs) Plan International in Kibera and Save the Children in Wajir. Below we describe the interventions in detail (see Fig. 2 for summary) and use administrative data collected during program monitoring by the implementing NGOs to summarize key indicators of implementation and take-up for each intervention (Table 1), demonstrating that fidelity of the interventions was high.

[FIG 2. Intervention Summary]

Rather than examining each single-sector intervention in isolation, because the theory of change posits synergies among them the study examined the effectiveness of different multi-sectoral packages of interventions, compared with a base intervention as follows:

| Intervention Package/Study Arm                                      | Abbreviation |
|--------------------------------------------------------------------|--------------|
| Violence Prevention Only                                           | V-only       |
| Violence Prevention + Education                                   | VE           |
| Violence Prevention + Education + Health                          | VEH          |
| Violence Prevention + Education + Health + Wealth Creation         | VEHW         |

Girls were randomized (described below) to one of the four combinations of interventions, or study arms. All four packages included the community-level violence prevention intervention. Three of the four included the education intervention, which provided conditional cash transfers. The final two combinations were “cash plus” and incorporated additional health and financial education components, each with specific programming designed to develop various skills and empower the girls. The mix of intervention packages were the same in Kibera and Wajir though several aspects of the specific interventions implemented were appropriately modified in each site.

The violence prevention intervention employed community conversations and contracts [51]. The conceptualization of violence was not limited to sexual and physical violence but incorporated the undervaluation of girls reflected by lack of education, female genital mutilation and early marriage. Implementing NGOs first established a committee of key stakeholders in each community and facilitated a series of dialogues to identify the local problems and constraints contributing to the undervaluation of girls and to violence against girls and women. The committees then developed action plans and a proposed budget to address causes and alleviate some of the local challenges facing adolescent girls.
The study site in Kibera was divided into seven areas and a committee formed in each. The committees began meeting in December 2015 and met on average 30.0 (SD 9.4) times through July 2017, by which time they had completed their action plans. All the plans focused on setting up new resource centers or libraries for girls in the community. Based on their proposals, committees were allocated approximately US$ 2000 each for the implementation of their action plans. In Wajir, a committee was formed in each of the 79 included communities and met on average 15.6 (SD 10.4) times over the intervention period, although in a few communities there were only a small number of organized meetings (and on average there were 4 fewer meetings in V-only clusters). By November 2017, 68 of 79 action plans had been completed, with the remaining ones finalized over the following six months. The Wajir action plans focused on improving village primary school infrastructure, for example purchasing additional desks, installing piped water or solar panels, and building new classrooms. Based on their proposals, committees were allocated between US$ 1500 and US$ 2000 each.

The education intervention included cash and in-kind transfers conditional on enrollment of the target girl in each of the three school terms per year and on her regular attendance during the terms. All girls were eligible for transfers upon confirmation of enrollment, regardless of whether they were in school prior to the program. The school year in Kenya begins in January but enrollment is permitted at the start of each term. There were four conditional transfers: 1) a cash transfer paid to the head of the household twice per term (once at the start of the term upon enrollment and then later in the term based on continued attendance), totaling ~US$ 11 in Kibera and ~US$ 15 in Wajir; 2) an in-kind school supply kit (including sanitary pads, a pair of underpants, a pen and notebook, soap and Vaseline) given directly to the girl at the start of each term upon enrollment and valued at ~US$ 6; 3) school fees paid directly to the school at the start of each term upon enrollment, up to ~US$ 7 for primary school and ~US$ 60 for secondary; and 4) an additional transfer made directly to the school, ~US$ 5 per girl per term paid at the same time as the school fees. This additional transfer to the school was intended to supplement school resources and provide incentives for added responsibilities of teachers, for example related to increased enrollments and required monitoring of attendance.

At the start of each school term, the implementing partners verified enrollment and based on that the program delivered all but the second installment of the household-level transfer which was conditional on attendance during the term. Biometric fingerprint reading devices were initially used at each school to monitor attendance. Technical and logistical problems (including substantial delays as students waited to comply and lack of cooperation by some schools) led to incomplete implementation of the biometric system by school staff. Consequently, after two terms the system was discontinued, a deviation from the original program design. From then on attendance was monitored (and conditionality applied) each term during two random visits to the school, one week apart. Girls absent from school during both visits were ineligible for the second household-level cash transfer payment for that term.

Take-up of the educational component of the intervention was high in both Kibera and Wajir. Ninety percent or more of girls randomized to a study arm including the education intervention received at least one household cash transfer. Out of a possible 12 transfers, girls received on average 9.5 (SD 3.7) in...
Kibera and 8.8 (SD 4.3) in Wajir (Table 1). School fee payments and receipt of school kits were similarly high relative to potential, except for modestly lower school fee transfers in Wajir where in one of the six terms transfers were not delivered to most schools due to a teachers’ strike. By design, there were no transfers to girls in the V-only study arm.

Table 1. AGI-K Intervention uptake, by site and study arm

| Education intervention | V-Only | VE | VEH | VEHW | Overall1 | V-Only | VE | VEH | VEHW | Overall1 |
|------------------------|--------|----|-----|------|---------|--------|----|-----|------|---------|
| Received at least one cash transfer, % | 0.0 | 92.7 | 90.1 | 94.6 | 92.5 | 0.0 | 88.2 | 87.5 | 89.9 | 88.5 |
| Cash transfers received (out of 12), mean | 0.0 | 9.4 | 9.2 | 9.9 | 9.5 | 0.0 | 8.7 | 8.7 | 9.0 | 8.8 |
| School fee payments received out of 6, mean | 0.0 | 4.9 | 4.9 | 5.0 | 5.0 | 0.0 | 3.9 | 3.9 | 3.9 | 3.9 |
| School kits received (out of 6), mean | 0.0 | 4.1 | 4.1 | 4.4 | 4.2 | 0.0 | 4.4 | 4.3 | 4.5 | 4.4 |

| Health intervention | | | | | | | | | | |
|---------------------|--------|----|-----|------|---------|--------|----|-----|------|---------|
| Total group meetings attended,2 mean | 0.0 | 0.0 | 34.5 | 37.6 | 36.0 | 0.0 | 0.0 | 30.8 | 35.2 | 33.0 |
| Attended at least 12 group meetings, % | 0.0 | 0.2 | 77.5 | 82.8 | 80.1 | 0.0 | 0.0 | 70.8 | 72.6 | 71.7 |
| Health and life skills sessions attended,3 mean | 0.0 | 0.0 | 31.6 | 22.9 | 27.3 | 0.0 | 0.0 | 30.0 | 19.9 | 24.9 |
| Attended at least 4 health and life skills sessions, % | 0.0 | 0.0 | 85.9 | 86.1 | 86.0 | 0.0 | 0.0 | 83.1 | 80.1 | 81.6 |

| Wealth creation intervention | | | | | | | | | | |
|-----------------------------|--------|----|-----|------|---------|--------|----|-----|------|---------|
| Financial education sessions attended,4 mean | 0.0 | 0.0 | 0.1 | 10.5 | 10.5 | 0.0 | 0.0 | 0.2 | 13.8 | 13.8 |
| Attended at least 4 financial education sessions, % | 0.0 | 0.0 | 2.1 | 80.7 | 80.7 | 0.0 | 0.0 | 0.0 | 76.2 | 76.2 |
| Opened savings account/received home bank,5 % | 0.0 | 0.5 | 0.3 | 81.9 | 81.9 | 0.0 | 0.0 | 0.0 | 78.5 | 78.5 |
| Received both annual savings incentives, % | 0.0 | 0.0 | 0.0 | 78.7 | 78.7 | 0.0 | 0.0 | 0.0 | 71.7 | 71.7 |

N

597 592 609 592 2,390 506 549 538 554 2,147

Notes: Source is program administrative data collected during program monitoring by the implementing NGOs.
1 Overall average across applicable study arms.
2 Groups met weekly over two years for a maximum of 100 meetings.
3 The health and life skills curriculum included 47 planned sessions in Kibera and 36 in Wajir.
4 The financial education curriculum included 19 planned sessions.
5 Savings accounts in Kibera and home banks in Wajir.

The health intervention consisted of weekly educational meetings in which designated groups of 20–25 girls met under the guidance of trained female mentors from the community. In Kibera groups were
segmented by age at the start of the intervention (11–12 versus 13–15-year-olds) and in Wajir by initial baseline schooling status (in school versus out of school). The group meetings included facilitated discussions following a comprehensive health and life skills curriculum developed by the program with time for open discussion, together aimed at empowering the girls. The health and life skills curriculum included units on nutrition, hygiene, human rights, sexual and reproductive health, leadership, gender-based violence and harmful traditional practices. Specific content differed across the sites (for example with greater emphasis on sexually transmitted diseases and their transmission in Kibera) and there were 47 sessions in Kibera and 36 in Wajir. Once a group had completed the entire curriculum the mentor could use subsequent meetings to repeat specific sessions. In Wajir, it was a significant challenge for the NGO to identify enough women willing and capable of serving as mentors, in part because of the low education levels of adult women residing in the communities. Consequently, at the outset there was substantial variation in how well mentors carried out their roles, and not all delivered the curriculum content effectively. To address this, for Wajir only the intervention design was modified and the sessions transformed into recorded audio scripts starting in June 2016. The groups listened together to the recordings, which maintained the discussion format including instructions on when to pause and what questions to discuss.

Over the course of the intervention, girls randomized to a study arm including the health intervention attended on average 36.0 (SD 24.0) group meetings in Kibera and 33.0 (SD 25.2) in Wajir (Table 1). Over 70% of girls attended at least 12 health and life skills sessions. In both Kibera and Wajir, overall average attendance at the group meetings was higher among girls in the VEHW than in the VEH study arm although since the total number of scheduled meetings across arms was the same the girls in VEH had higher average exposure to sessions in the health and life skills curriculum. By design, girls in the VE (or V-only) study arms were not included in the group meetings though administrative data indicate that a negligible fraction attended in Kibera.

Last, the wealth creation intervention integrated financial education into the mentor-led group meetings, to promote economic empowerment. A 19-session financial education curriculum included units on saving, setting financial goals, budgeting, how to prioritize spending and financial negotiation. Specific content within each session differed across Kibera and Wajir; for example, whereas home savings banks were covered in both sites, formal bank accounts were discussed only in Kibera since they were largely inaccessible to girls in Wajir. (The detailed curricula for both the health and life skills and the financial education sessions are available at https://www.popcouncil.org/research/adolescent-girls-initiative-action-research-program.) Participating girls received two annual incentives of ~US$ 3 to allow them to put into practice skills covered in the sessions. In Kibera, girls opened a Smata Youth Account with the Kenya Post Office Savings Bank (Postbank) after the first unit. The accounts had a 200 KES (~US$ 2) minimum opening balance and were managed by the girls who had to select an adult co-signatory to open the account and whose signature was needed to make withdrawals. In Wajir, the program provided girls with a home savings bank.
Over the course of the intervention, girls randomized to the VEHW study arm attended on average 10.5 (SD 7.0) group meetings related to financial education in Kibera and 13.8 (SD 9.8) in Wajir (Table 1). More than 75% of girls attended at least four financial education sessions. By design, the sessions for girls in the VEH study arm did not include the financial education curriculum, though administrative data indicate a few financial education sessions were offered to a small number of groups in the wrong study arm and a few girls in Kibera attended group sessions outside their study arm. Approximately 80% of eligible girls received at least one of the two annual savings incentive transfers and opened a savings bank in Kibera or had a home bank in Wajir.

**Randomization**

The unit of randomization differed across the two sites with individual-level randomization done in Kibera and cluster-level randomization in Wajir. High population density and mobility in urban Kibera, along with widespread school availability in and near the settlement, made it possible to target a large number of girls with excludable interventions so that an individual-level randomized design was feasible. At the same time, the high mobility within Kibera (linked to often uncertain land/house tenure) and school attendance patterns in which girls attend both public and private schools of very different sizes throughout the area and in adjacent areas made it less advantageous to consider a cluster design in this setting [52]. This resulted in increased statistical power compared to a cluster randomized evaluation with the same number of girls. In less densely populated Wajir, with its small and cohesive village settlements, individual-level randomization was not feasible but a cluster-level design allowed for randomization of different interventions at the village level, while benefiting a total number of girls similar to Kibera. In Wajir, clusters were defined as village settlements with one public primary school. This ensured that girls had access to a school and to a central location for group meetings (often but not always held in schools). A total of 80 clusters were identified in three (of four) pre-devolution administrative districts as defined in the 2009 national census: 20 clusters in Wajir West, 28 in Wajir East and 32 in Wajir South. For security reasons, the program was subsequently not implemented in one cluster (VE study arm in Wajir West) and girls in that village were not followed after baseline.

Assignment to study arms was done publicly for transparency and to strengthen program acceptance. In Kibera, girls were randomly assigned to study arms in February 2015 during a public meeting attended by local leaders and other stakeholders. An Excel spreadsheet with an anonymous ID number for each girl was projected onto a screen and a random number generated for each girl. The list was then put in ascending order based on the random number and divided into four equally sized groups. Each group was assigned to a study arm when four stakeholders in turn each blindly drew a slip of paper from a set of four, each one indicating a study arm. In Wajir in each of the three districts, public meetings were held between April–June 2015 with local leaders and other stakeholders. A list of all the clusters in the district was displayed and a representative from each cluster blindly drew a slip of paper indicating a study arm from a set with one for each cluster in the district, equally divided across the four study arms.

By design, all community members living in the study areas were exposed to the violence prevention intervention with its community conversations model and subsequent action plans. For the other
intervention components, the primary beneficiaries were resident girls ages 11–14 years old at the start. In Kibera, a complete household listing was done prior to the baseline survey to identify girls eligible for the program. Girls were eligible at baseline if they were residing in the study area and not currently enrolled in boarding school. A random sample of eligible girls was selected for the baseline survey (with only one girl chosen from households with more than one eligible girl although the other eligible girls in the household were invited to participate in the intervention in the same study arm, with a total of 1,937 invited to participate in VE, VEH and VEHW interventions in Kibera). In Wajir, where the vastness of the terrain complicated survey logistics and increased survey costs, a rapid household listing was conducted in each cluster just prior to the baseline survey. All girls 11–14 years old residing in the village and not currently enrolled in boarding school (<3%) were eligible for the program. In clusters with fewer than 40 households with an eligible girl all households and girls ages 11–14 years old were selected for the baseline sample interview. For this reason, in smaller clusters multiple eligible girls could be interviewed in a single household; this occurred in fewer than 100 households in total. In clusters with 40 or more such households, team leaders used predetermined cluster-specific random number lists to randomly select 40 households and, within each household, one girl for the baseline sample interview. In practice, difficulties confirming accurate ages implied some girls younger than 11 or older than 14 were also included. All other eligible girls in the cluster, however, were invited to participate in the program in the same study arm with a total of 2,844 invited to participate in VE, VEH and VEHW interventions in Wajir.

The baseline survey was conducted in both sites prior to the start of the intervention, and a follow-up panel survey two years later at the end of the intervention. All girls interviewed at baseline were targeted for the two-year follow-up. In Kibera the initial household listing took place between November 2014–January 2015, baseline data was collected between late February–April 2015 and the two-year follow-up survey between May–July 2017. In Wajir, baseline data was collected between March–May 2015 and the two-year follow-up survey between July–September 2017. In Kibera, names of randomized beneficiaries were not released until after the baseline and interviewers were blind to randomization status. In Wajir, randomization occurred after fieldwork in each district.

**Outcomes**

In this paper we analyze the mediating factors the theory of change predicts would have been impacted during early and mid-adolescence. These are the secondary outcomes of the AGI-K trial as outlined in Table 1 of the study protocol [49], reproduced in Appendix Table 1. Below we describe the specific measures for each outcome. For some domains we considered additional related indicators and in part for this reason we also construct summary measures for each domain (described in the methods). Appendix Table 9 provides the detailed variable definitions and Cronbach alphas for index scale measures.

The research design does not permit identification of impacts attributable to the violence prevention intervention alone. It is possible, however, to examine whether different packages of interventions were more effective than V-only in influencing violence-related outcomes and gender attitudes that are also related to other interventions if there are synergies between the intervention components. Given our broad
conceptualization of violence the theory of change points most notably to the potential for the health intervention to have potential synergies and also influence some of these outcomes. We examined three measures capturing the two indicators outlined in Appendix Table 1: experience of gender-based violence and gender norms and attitudes for the girls. ‘Experienced violence by a male in the past year’ was a binary indicator equal to 1 if the girl responded yes to at least one of 15 items measuring different dimensions of emotional, physical and sexual violence perpetrated by a male. ‘Gender equitable attitudes’ were measured on a 10-item scale of agree/disagree statements describing gender norms, with one point attributed for each answer reflecting the more gender equitable option. This outcome was not measured at baseline. And lastly, ‘gender equitable schooling attitudes’ were measured on a 4-item scale of agree/disagree statements describing gender schooling norms.

The main indicators specified for the education intervention were ‘highest grade completed’ and ‘completed primary,’ a binary indicator equal to 1 if the girl had finished primary school. Primary school in Kenya consists of eight grades and a critical bottleneck in schooling is advancing from primary to secondary school. Therefore in Kibera where schooling attainment was substantially higher, we also considered two conditional (binary indicator) outcomes examining progression during that transition: ‘conditional primary school completion’ among respondents who at baseline had completed Class 6 or 7 but had not yet completed primary school; and ‘transition to secondary school’ among respondents who at baseline had completed Class 6, 7 or 8 but had not yet enrolled in secondary school. Potentially relevant in both sites, we also examined ‘school enrollment,’ a binary indicator equal to 1 if the girl attended school in the current survey year and the most common schooling-related outcome analyzed for conditional cash transfer programs [53].

For the health intervention, we assessed three measures of sexual and reproductive health (SRH) knowledge. The first was a binary indicator equal to 1 if the girl ‘knows the most fertile period during menstrual cycle.’ The other two were introduced only at the two-year follow-up given the relatively young ages at baseline: ‘Knows method of modern contraception’ was a binary indicator equal to 1 if the girl was able to name at least one of seven contraceptive methods without prompting and ‘SRH myths knowledge,’ was the number correct on a seven-item scale of agree/disagree statements describing common SRH misconceptions. ‘General self-efficacy’ was measured at both baseline and two-year follow-up, as a score from 1–6 based on six agree/disagree statements on how effectively the girls handle unexpected or problematic situations and related to her decision making skills [54]. Last, ‘condom self-efficacy’ was measured at the two-year follow-up (for Kibera only since usage in Wajir was negligible) as a score ranging from 5–25 derived from five questions (each scored 1–5) on how confident a girl was that she could effectively discuss and use condoms, with higher scores indicating higher condom self-efficacy.

Outcomes related to the wealth creation intervention included ‘financial literacy’, measured as a score made up of 10 items capturing knowledge, attitudes and behaviors related to various financial practices, and ‘saving behavior’ a binary indicator equal to 1 if a girl reported saving any money, formally or informally, in the past six months. Participation in income generating activities, a third indicator originally
conceived for this domain (Appendix Table 1) was not examined as less than 5% of girls reported working, likely due to their young ages.

The theory of change underscores the potential importance of community norms and household-level economic resources for schooling, for example to cover school fees and pay other school-related expenses. Although not specified in Appendix Table 1, we used household level outcomes to assess program impacts on related outcomes. We examined ‘household education norms,’ measured as a binary indicator equal to 1 if the household head expects the girl to complete secondary school. We also considered household expectations for age at marriage, but at the two-year follow-up one-quarter of responses in Kibera and one-half in Wajir indicated “don’t know” so that analysis of this information was not meaningful. Last, we examined the first component from a principal components analysis (PCA) estimated using ten variables measuring assets, housing characteristics and cash liquidity to derive a household wealth index [52]. The index was divided into quintiles with higher quintiles representing higher wealth.

Sample Size Calculations

The study was powered to detect differences in the number of grades attained and prevalence of first birth between V-only and each of the three other study arms at endline – four years after the start of the intervention, when girls in the sample would be 15–18 years old [49]. For Kibera, we estimated endline average grades attained of 8.3 years (and correlation coefficient 0.33) using the 2008-09 Kenyan Demographic and Health Survey (KDHS) [55] and an endline birthrate of 15.4% using the 2012 Nairobi Cross-Sectional Slum Survey (NCSSS) [14] and used a power of 80% to calculate sample size. Based on individual randomization, the estimated final sample size was 600 girls per arm (750 girls per arm at baseline, assuming a loss to follow-up of 20%). Because of a higher than expected proportion of ineligible girls after complete enumeration of Kibera, however, the attained baseline sample included approximately 600 girls per arm. After attrition this allows a minimum detectable difference of 0.55 grades of schooling between any two study arms. For Wajir, we estimated endline average grades attained of 2.8 years (and correlation coefficient of 0.26) and an endline birthrate of 17.6% using data from the Northeastern Province from the 2008-09 KDHS [55] and a power of 80% to calculate sample size. Based on cluster randomization, the estimated final sample size was 20 clusters per arm with 32 girls per cluster (40 girls per cluster at baseline, assuming a loss to follow-up of 20%). Because of differences between population estimates and the actual number of eligible girls residing in these communities, however, the attained baseline sample included 20 clusters per arm with an average of 27 girls per cluster [49]. After attrition this allows a minimum detectable difference of 0.49 grades of schooling between any two study arms. Because the estimated models control for additional variables in both trials, the minimum detectable differences may be smaller.

Statistical Methods

We estimated the intent-to-treat (ITT) impact of each nested combination of single-sector interventions relative to the V-only arm. ITT was defined as girls randomized to a specific study arm in the Kibera site,
and as girls living at baseline in a village randomized to a specific study arm in the Wajir site, irrespective of their actual participation in the program. Analysis of covariance (ANCOVA) models were used to obtain ITT estimates from the two-year follow-up survey for each site. Scales were converted into z-scores, dividing by the standard deviation of the V-only group at baseline when available; otherwise they are divided by the standard deviation of the V-only group at the two-year follow-up.

Because several indicators were evaluated, we accounted for multiple hypotheses testing by: 1) grouping outcomes into families by domain and examining summary measures for each domain; and separately 2) recalculating statistical significance. First, for each indicator we constructed a z-score based on the mean and standard deviation of the V-only study arm at the two-year follow-up. Using those, we constructed an inverse covariance weighted index for each family of outcome indicators, re-standardizing each the index to be mean 0 and SD 1 [56]. We then estimated the same ITT model on this summary z-score for each domain. (As an alternative index we calculated the simple average z-score for the set of indicators in each domain [57]; results using this alternative summary z-score are substantively the same.) Second, we recalculated statistical significance using the Benjamini and Hochberg (1995) false discovery rates (FDR) and report the adjusted q-values in the appendix, discussing any differences in the text [58]. For each site, these multiple hypothesis testing corrections are done for all individual items together and, separately, for the four summary measures together.

Prior to presenting the impact estimates, we assessed balance on baseline characteristics across the experimental arms for the non-attributing sample after two years to explore potential bias from non-random attrition. In addition to this consideration of baseline balance, we examined the extent and correlates of attrition in the study using ordinary least squares to estimate the probability of successful interview in the two-year follow-up for each site and whether the correlates of attrition differed by study arm. We then used ordinary least squares stepwise backward elimination with adjusted \( R^2 \) as the information criterion [59] to develop a parsimonious model of attrition and constructed inverse probability weights, and report weighted regressions in the appendix.

All regressions controlled for age (using a binary indicator for each age in years at baseline) and when available the baseline value of the outcome measure. Regressions for Wajir also controlled for stratification with binary indicators for the districts. In the appendix, we report adjusted regressions with additional baseline controls for cognitive skills, schooling, parental characteristics and household wealth to account for any initial imbalance and improve precision [49]. Last, in the appendix we also present results combining all three arms with the education intervention (VE, VEH and VEHW) and estimate the average overall treatment.

Regressions for the individual-level randomization in Kibera were estimated with robust standard errors and for the cluster-level randomization in Wajir with robust standard errors accounting for clustering at the village level. We define statistical significance at 0.05. Statistical analysis was conducted using Stata 15.1.
Results

Figures 3a and 3b show the sample flow and analytical samples by trial and study arm during which updates during fieldwork (particularly in Kibera where there was a lag between the initial listing and the baseline survey) led to reduced samples excluding ineligible girls. Notably, accurately capturing age in both contexts benefited from multiple visits.

[FIG 3a. Kibera Sample Flow]

[FIG 3b. Wajir Sample Flow]

Baseline data included 2,390 girls in the Kibera site and 2,147 girls in the Wajir site. Baseline survey non-response was 6.2% in Kibera and 6.5% in Wajir and most commonly due to unavailability of the girl for interview (because she was not located, temporarily away or after the rapid listing it was determined that she was not a usual resident) and in some cases (about one-third in Kibera and 10% in Wajir), refusal. Because there was substantial residential mobility for girls in the study sites (particularly in Kibera), to keep attrition at a minimum the two-year follow-up survey tracked girls to their new locations. In Kibera this included following girls to 27 (out of 47) different counties throughout Kenya; about one-fifth of girls re-interviewed in the two-year follow-up were located outside of Nairobi City County. In Wajir mobility was lower and girls were tracked to new locations throughout the county as well as a small number outside the county; approximately 14% were interviewed in a location different from the baseline. At the two-year follow-up in 2017, 91.6% of girls from the Kibera baseline sample were re-interviewed and 88.9% from the Wajir sample. The final analysis sample included 2,190 girls from Kibera and 1,909 from Wajir. Reasons for loss to follow-up are shown in Figs. 3a and 3b. The most common were failure to locate girls who had moved or unavailability of the girl during the interview period. Direct refusal was more common in Kibera (particularly in the V-only arm), but rare in Wajir. In Wajir, the 15 girls in the cluster dropped from the trial in the VE arm due to security concerns were not followed.

Figure 3 also shows that two-year follow-up rates differed by study arm (85–95%); therefore, we tested baseline balance for selected background characteristics using the non-attrited sample. Table 2 (Kibera) and Table 3 (Wajir) present baseline means for all available outcomes for the sample of girls interviewed at the two-year follow-up (outcomes not included were the new measurements introduced in the two-year follow-up). The samples in the two-year follow-up in each study arm were balanced on a range of baseline characteristics and there were no large differences and only one significant difference for the general self-efficacy score in Wajir. Appendix Tables 2 and 3 report means by intervention for the full baseline sample [60].

We estimated linear probability models for each study site predicting re-interview in the two-year follow-up to examine its correlates and characterize potential attrition bias (Appendix Tables 4a and 4b). In addition to binary indicators for the study arms, the models included baseline measures of age, cognitive test score, school enrollment (Wajir only), grade attainment, parental education, co-residence with parents, household wealth and district (Wajir only). Conditional on those covariates, in Kibera the probability of re-
interview was nearly 10 percentage points higher in all three arms compared to V-only (Appendix Table 4a, column 1) and higher for the youngest, those with marginally higher cognitive test scores and those who resided with both of their parents. Expanding the model to also include interactions of the baseline controls with an indicator for each study arm (column 2), however, indicates only one individually significant variable (paternal schooling) between the relationship of the baseline controls and attrition, and neither the joint test of all interactions nor joint tests of interactions for each study arm are significant. Conditional on the covariates, in Wajir the probability of re-interview was about 4 percentage points higher in the VEH and VEHW arms compared to V-only (Appendix Table 4b, column 1), and higher for the youngest, those initially enrolled in school or with higher grade attainment, and those living in East Wajir. Expanding the model to also include interactions of the baseline controls with an indicator for each study arm (column 2) indicates only a few significant differences between the relationship of the baseline controls and attrition. However, the joint test of all interactions and joint tests of interactions for the VEH and VEHW study arm are significant. The balance results across study arms and these patterns for attrition suggest that while there are some differences (especially in Wajir), large systematic biases in the ITT estimates threatening internal validity are unlikely. Nevertheless, to assess further the possibility of bias below we also characterize the results controlling for these additional covariates and also accounting for attrition using inverse probability weights.

At baseline in Kibera, girls averaged 12.6 years old and about half lived with their parents, a majority of whom had completed primary school. Nearly one-third of the girls had experienced violence perpetrated by a male in the past year, notably high given such violence is often underreported. Virtually all girls in Kibera were enrolled in school and average grade attainment was 5.7 years, two years below completed primary consistent with their ages. Over 90% were literate in Swahili and English and all but a few girls were expected to complete secondary school. Reproductive health knowledge was low, with fewer than one in ten girls identifying the most fertile period during the menstrual cycle. Girls scored on average 4 out of 6 in general self-efficacy; many of the hypothetical situations posed in the scale proved difficult for younger girls to understand in both sites. On average girls scored nearly 6 out of 10 on financial literacy and about one-quarter had saved any money in the past six months.

At baseline in Wajir, girls averaged 11.9 years old and about three-quarters lived with their parents, very few of whom had ever themselves attended school. Girls were younger in Wajir on average largely because there was no time gap between the household listing and baseline survey unlike in Kibera. In both settings some girls determined to be a little outside the initial age ranges after initial inclusion, for example during the two-year follow-up survey, were retained in the samples (and all analyses control for age). Less than 5% experienced violence perpetrated by a male in the past year, although as in Kibera underreporting is possible. Approximately three-quarters of girls were enrolled in school and average grade attainment was only 2.9 years, about half that of their counterparts in Kibera. Low levels of schooling were reflected in literacy with less than 40% literate in both Swahili and English. Although lower than in Kibera, however, more than 80% of girls were still expected by their household to complete secondary school. Reproductive health knowledge and general self-efficacy were even lower in Wajir than in Kibera: hardly any girls were able to identify the most fertile period during the menstrual cycle, and they
scored on average 2 out of 6 in general self-efficacy. On average girls scored 4 out of 10 in financial literacy, and almost none had saved any money in the past six months.

Table 2. Kibera baseline means for key outcomes among analytical sample at two-year follow-up, by study arm

|                              | (1) | (2) | (3) | (4) | (5) p-value |
|------------------------------|-----|-----|-----|-----|-------------|
| **Background**               |     |     |     |     |             |
| Age, mean (sd)              | 12.6| 12.5| 12.6| 12.5| 0.707       |
| Cognitive score (0-16), mean (sd) [n=2,173] | 8.2 (3.0) | 8.4 (3.0) | 8.3 (3.1) | 8.3 (3.2) | 0.732       |
| Lives with both parents, % [n=2,174] | 52.1 | 55.9 | 51.0 | 53.3 | 0.384       |
| Mother completed primary school, % [n=2,040] | 62.4 | 63.3 | 62.5 | 64.1 | 0.938       |
| Father completed primary school, % [n=1,803] | 77.7 | 78.9 | 74.7 | 79.6 | 0.305       |
| **Violence Prevention**     |     |     |     |     |             |
| Experienced violence by a male in the past year, % | 29.0 | 29.8 | 30.6 | 32.2 | 0.703       |
| Positive gender attitudes score (0-4), mean (sd) | 3.6 (0.7) | 3.5 (0.7) | 3.6 (0.7) | 3.6 (0.7) | 0.458       |
| **Education**               |     |     |     |     |             |
| Grade attainment, mean (sd) | 5.7 (1.4) | 5.7 (1.3) | 5.7 (1.4) | 5.7 (1.3) | 0.990       |
| Primary school completion, % | 7.9 | 5.9 | 6.7 | 6.1 | 0.600       |
| Enrolled in current school year, % | 99.2 | 99.1 | 98.6 | 99.3 | 0.713       |
| Literate in Swahili and English, % [n=2,173] | 92.2 | 93.6 | 92.9 | 94.0 | 0.700       |
| **Health**                  |     |     |     |     |             |
| Knows most fertile period during menstrual cycle, % | 8.7 | 8.2 | 7.0 | 5.8 | 0.243       |
| General self-efficacy score (0-6), mean (sd) | 3.8 (1.7) | 4.0 (1.6) | 3.9 (1.6) | 4.0 (1.6) | 0.493       |
| **Wealth Creation**         |     |     |     |     |             |
| Financial literacy score (0-10), mean (sd) | 5.8 (1.9) | 5.6 (1.9) | 5.7 (1.9) | 5.8 (1.9) | 0.426       |
| Saved money in the past six months, % | 27.8 | 25.7 | 26.4 | 28.4 | 0.722       |
| **Household-level**         |     |     |     |     |             |
| Household expects girl to complete secondary, % [n=2,222] | 99.8 | 99.6 | 99.8 | 99.8 | 0.934       |
| Household wealth quintile (1-5), mean (sd) [n=2,236] | 3.1 (1.4) | 3.1 (1.4) | 3.0 (1.4) | 3.0 (1.4) | 0.631       |
| **Sample by arm when n=2,190** | 507 | 561 | 569 | 553 |             |

Notes: P-values from F tests for joint differences across study arms to test baseline balance for the sample of non-attributors in the two-year follow-up. n = 2,190 unless otherwise indicated.

Table 3. Wajir baseline means for key outcomes among analytical sample at two-year follow-up, by study arm
Table 4 presents results from the ITT analyses for the Kibera site. The first column displays the means of the two-year follow-up outcomes for the V-only study arm. The next three columns present the ITT estimates relative to V-only for the VE, VEH and VEHW study arms allowing assessment of the program effects on the secondary outcomes for each study arm. To explore whether there were incremental effects across study arms with additional interventions, in particular assessment of cash versus cash plus programming, the final three columns 5–7 present differences between pairs of study arms with education intervention, based on the ITT estimates in columns 2 to 4.

The intervention led to reductions in the experience of male-perpetrated violence between 4–9 percentage points compared with an average of 42% in the V-only arm, statistically significant for the VE and VEH arms, but VEH is not significant after consideration of multiple hypothesis testing based on the FDR q-
value (Appendix Table 5). There was a modest reduction in gender schooling attitudes of about 0.1 SD in VEHW, but no effect on overall gender equitable attitudes or on the violence prevention summary z-score (Table 5, bottom panel). For schooling, there were small positive effects on grade attainment of about 0.05 grades (only significant for VEHW) and small positive but insignificant effects on primary school completion and enrollment. Examining these three indicators together in a summary variable suggests an increase of about 0.1 SD for the VEHW arm only. Consideration of the conditional schooling variables indicates VEHW increased the probability of completing primary school and, separately, transitioning to secondary school by 7 percentage points. Positive and statistically significant effects are found for the VEH and VEHW arms in SRH knowledge outcomes and condom self-efficacy. There was a greater than 10 percentage point increase in knowledge of at least one method of modern contraception compared with 56% knowledge in V-only, and a 0.2 SD increase in general SRH knowledge and more than 0.1 SD increase in condom self-efficacy. A positive and statistically significant effect of more than 0.1 SD is observed for general self-efficacy in the VE arm. Estimation of the impact on the summary health outcome average z-score yields significant increases of about 0.3 SD for the VEH and VEHW study arms. Large positive and statistically significant effects on both financial literacy and saving behavior are found for the VEHW arm (and correspondingly in the summary measure), but not elsewhere. For example, savings increased by 20 percentage points compared with 45% in V-only. There were no effects of the interventions on the household-level wealth quintile and, unsurprisingly given the near-100 percent levels at baseline, no effect on household expectations the girl would complete secondary school.

All results are robust to the inclusion of additional controls and to weighting for attrition, with significant point estimates changing only marginally and remaining significant at a 0.05 level (Appendix Table 5). The results for summary variables are also robust to these variations (Appendix Table 6). In addition, consideration of the combined education treatments (Appendix Table 6, column 5) indicate for all but the violence prevention domain positive significant effects of nearly 0.1 SD for education and 0.2 SD for health and wealth creation.

Examining columns 5–7 in Table 4, there were few significant differences between the effects of study arms with the education intervention for violence prevention and education outcomes. Several health indicators, including the summary indicator, were significantly larger in the VEH and VEHW arms compared with the VE arm. One notable exception is general self-efficacy which showed improvement only in the VE study arm. The two wealth creation indicators (and the summary measure) were larger in the VEHW compared with the VE and VEH arms.

Table 4: Kibera estimated effects of intent-to-treat
| Variables                                                                 | (1) V-Only two-year follow-up Mean | (2) VE Estimate         | (3) VEH Estimate        | (4) VEHW Estimate       | (5) VEH vs VE (3)-(2)  | (6) VEHW vs VE (4)-(2) | (7) VEHW vs VE (4)-(3) |
|--------------------------------------------------------------------------|------------------------------------|-------------------------|-------------------------|-------------------------|-----------------------|------------------------|------------------------|
| Experienced violence by a male in the past year (=1)                      | 0.422                              | -0.088**                | -0.059*                 | -0.042                  | 0.028                 | 0.046                  | 0.018                  |
| 95% CI                                                                   | [0.38, 0.47]                       | [-0.14, -0.03]          | [0.00]                  | [0.02]                  | [0.08]                | [0.10]                 | [0.07]                 |
| Gender equitable attitudes z-score¹                                      | 0.000                              | -0.036                  | 0.054                   | 0.078                   | 0.090                 | 0.114*                 | 0.024                  |
| 95% CI                                                                   | [-0.09, -0.01]                     | [0.08]                  | [0.17]                  | [0.19]                  | [0.20]                | [0.23]                 | [0.14]                 |
| Positive gender schooling attitudes z-score                               | 0.211                              | -0.024                  | -0.091†                 | -0.137*                 | -0.067                | -0.113*                | -0.046                |
| 95% CI                                                                   | [0.14, 0.28]                       | [-0.12, 0.07]           | [-0.19, 0.01]           | [-0.24, -0.03]          | [-0.17, -0.03]        | [-0.22, -0.01]         | [-0.15, 0.06]          |
| **Education**                                                            |                                    |                         |                         |                         |                      |                        |                        |
| Grade attainment                                                         | 7.501                              | 0.052†                  | 0.048†                  | 0.067*                  | -0.003                | 0.016                  | 0.019                  |
| 95% CI                                                                   | [7.38, 7.62]                       | [0.00, 0.11]            | [0.01, 0.10]            | [0.01, 0.12]            | [0.05]                | [0.06]                 | [0.07]                 |
| Primary school complete (=1)                                             | 0.517                              | 0.020                   | 0.017                   | 0.032                   | -0.004                | 0.011                  | 0.015                  |
| 95% CI                                                                   | [-0.03, 0.07]                      | [-0.03, 0.07]           | [-0.02, 0.08]           | [-0.05, -0.03]          | [-0.05, -0.04]        | [0.05]                 | [0.06]                 |
| Enrolled in current school year (=1)                                     | 0.959                              | 0.005                   | 0.011                   | 0.020†                  | 0.006                 | 0.015                  | 0.010                  |
| 95% CI                                                                   | [0.94, 0.98]                       | [0.03]                  | [0.03]                  | [0.04]                  | [0.03]                | [0.03]                 | [0.03]                 |
| Conditional primary school complete (=1)² [n=1,104]                       | 0.887                              | 0.037                   | 0.020                   | 0.070**                 | -0.016                | 0.033                  | 0.050*                 |
| 95% CI                                                                   | [0.85, 0.93]                       | [-0.01, 0.09]           | [-0.03, 0.07]           | [0.02, 0.12]            | [-0.06, -0.03]        | [0.01, -0.07]          | [0.09]                 |
| Conditional transition to secondary school (=1)³ [n=1,131]                | 0.836                              | 0.036                   | 0.035                   | 0.071*                  | -0.001                | 0.036                  | 0.037                  |
| 95% CI                                                                   | [0.79, 0.88]                       | [0.10]                  | [0.09]                  | [0.13]                  | [0.05]                | [0.09]                 | [0.09]                 |
| **Health**                                                               |                                    |                         |                         |                         |                      |                        |                        |
| Knows most fertile period during menstrual cycle (=1)                    | 0.087                              | 0.016                   | 0.019                   | 0.022                   | 0.003                 | 0.006                  | 0.003                  |
| 95% CI                                                                   | [0.06, 0.11]                       | [0.05]                  | [0.05]                  | [0.06]                  | [0.04]                | [0.04]                 | [0.04]                 |
| Knows method of modern contraception¹ (=1) [n=2,175]                      | 0.555                              | -0.007                  | 0.130***                | 0.119***                | 0.137***              | 0.125***               | -0.011                 |
| 95% CI                                                                   | [0.51, 0.60]                       | [-0.06, 0.05]           | [0.07, 0.19]            | [0.06, 0.18]            | [0.08, 0.19]          | [0.07, 0.18]           | [0.04]                 |
| iRH myths knowledge z-score¹ [n=1,948]                                    | 0.000                              | 0.016                   | 0.213**                 | 0.158*                  | 0.197**               | 0.142*                 | -0.055                 |
| 95% CI                                                                   | [-0.09, 0.09]                      | [0.01, 0.14]            | [0.34]                  | [0.29]                  | [0.31]                | [0.26]                 | [0.07]                 |
| Variable | Estimate | SE | 95% CI | P-value |
|----------|----------|----|--------|---------|
| General self-efficacy z-score | 0.325 | 0.152** | [0.06, 0.58] | 0.000 |
| 95% CI | [0.25, 0.40] | 0.25 | [0.06, 0.58] | 0.000 |
| Condom use self-efficacy z-score | 0.000 | 0.038 | [-0.10, 0.14] | 0.908 |
| 95% CI | [-0.22, 0.19] | 0.13 | [0.06, 0.58] | 0.000 |
| Financial literacy z-score | -0.085 | 0.014 | [-0.11, 0.04] | 0.020 |
| 95% CI | [-0.17, 0.00] | 0.13 | [-0.11, 0.04] | 0.020 |
| Saved money in the past six months (=1) | 0.448 | 0.017 | [0.36, 0.53] | 0.000 |
| 95% CI | [-0.04, 0.15] | 0.08 | [0.36, 0.53] | 0.000 |
| Household wealth quintile | 2.823 | 0.101 | [2.70, 2.95] | 0.000 |
| 95% CI | [-0.06, 0.21] | 0.26 | [0.36, 0.53] | 0.000 |
| Expected girl to complete secondary school (=1) | 0.994 | 0.002 | [0.98, 1.01] | 0.000 |
| 95% CI | [-0.01, 0.01] | 0.01 | [0.98, 1.01] | 0.000 |
| Violence prevention outcomes summary index z-score | 0.000 | 0.066 | [-0.05, 0.12] | 0.908 |
| 95% CI | [-0.13, 0.02] | 0.19 | [-0.05, 0.12] | 0.908 |
| Education outcomes summary index z-score (grade, primary, enrol) | 0.000 | 0.062 | [-0.04, 0.08] | 0.908 |
| 95% CI | [-0.16, 0.05] | 0.17 | [-0.04, 0.08] | 0.908 |
| Health outcomes summary index z-score | 0.000 | 0.113† | [0.00, 0.23] | 0.061 |
| 95% CI | [-0.14, 0.05] | 0.23 | [0.00, 0.23] | 0.061 |
| Wealth creation outcomes summary index z-score | 0.000 | 0.015 | [0.00, 0.04] | 0.908 |
| 95% CI | [-0.08, 0.00] | 0.13 | [0.00, 0.04] | 0.908 |

Notes: The table reports two-year follow-up means for V-only in column 1, the estimated ITT effect for each study arm relative to V-only in columns 2–4 and differences in the estimated ITT effects across study arms in columns 5–7. Column 5 compares the estimates for VEH to VE, column 6 compares VEHW to VE, and column 7 compares VEHW to VEH. For example, the estimate in column 7 for 'Experienced violence by a male in the past year' (0.018) is the difference between the estimate for VEHW (-0.042) in column 4 and the estimate for VEH (-0.059) in column 3. Minor differences in the reported differentials compared to the estimates presented in columns 2–4 are due to rounding. Numbers in square brackets indicate 95% confidence intervals. Regressions
were estimated with robust standard errors and included controls for age and the outcome measured at baseline unless otherwise noted. N = 2,190; sample is smaller for some individual outcomes due to missing data as indicated.

1 No baseline control for outcome variable available.
2 Among girls who had completed Class 6 but had not yet completed Class 8 at baseline.
3 Among girls who had completed Class 6 but had not yet enrolled in secondary school at baseline.
4 Violence prevention indicator reverse coded prior to inclusion in summary variable.

*** p<0.001, ** p<0.01, * p<0.05, † p<0.1

Table 5 presents parallel results from the ITT analyses for the Wajir site. There were few effects on outcomes related to violence prevention and after accounting for multiple hypothesis testing no significant effects (Appendix Table 7), unsurprising given the research design. There were large significant effects on schooling, approximately 0.2 additional grades and increased enrollment of 7–14 percentage points compared to an enrollment rate of 80% in V-only. This improvement is on par with some of the most effective CCT programs for schooling elsewhere [53]. There was no increase, however, in completed primary school, likely reflecting the low starting levels of schooling for most girls at the start of the intervention. The point estimates for effects on health outcomes suggest mixed results, although none of the negative estimates for knowing the most fertile period or a modern method of contraception are significant after accounting for multiple hypothesis testing. There were substantial significant improvements for sexual and reproductive knowledge of 0.3 SD or more for VE and VEH. There were no effects on financial literacy but positive and statistically significant effects for the VEH (not significant after accounting for multiple hypothesis testing) and VEHW arms in savings behavior, and the effect for VEHW was a substantial 40 percentage point increase on a base of under 2% in V-only. At the household level, there was an apparent unexpected decline in wealth quintile for the VE study arm, not significant after accounting for multiple hypothesis testing. A robust significant increase of about 5 percentage points (compared with 86% in V-only) was seen for household expectations the girl would complete secondary school for the VE study arm.

Significant results are robust to the inclusion of additional controls and to weighting for attrition, with point estimates and significance levels only changing marginally for the majority of outcomes (Appendix Table 7). The results for summary variables are also robust to these variations (Appendix Table 8). In addition, consideration of the combined education treatments (Appendix Table 8, column 5) indicates positive significant effects of 0.2 SD for education and more than 1 SD for wealth creation.

There are only a few significantly different effects between study arms with the education intervention in Wajir in columns 5–7 of Table 5. There was a significant difference between VEHW and VEH in violence experienced by a male, mirrored by a significant difference between the study arms in the violence prevention summary measure. Reflecting impacts on enrollment in the VE arm twice the size of the others, both VEH and VEHW had significantly lower impacts on enrollment (6–7 percentage points).
Effects on financial literacy and savings behavior were substantially larger in the VEHW arm compared to the other two study arms, and most significant.

Table 5: Wajir estimated effects of intent-to-treat
| Violence Prevention |       |       |       |       |       |       |
|---------------------|-------|-------|-------|-------|-------|-------|
| Experienced violence by a male n the past year (=1) [n=1,878] | 0.038 | -0.006 | 0.015 | -0.022 | 0.021 | -0.017 |
| 95% CI | [0.01, 0.06] | [0.03] | [0.05] | [0.01] | [0.06] | [0.01] |
| Gender equitable attitudes z-score [n=1,903] | 0.000 | -0.171 | -0.208* | -0.018 | -0.037 | 0.153 |
| 95% CI | [-0.17, 0.17] | [0.05] | [-0.02] | [0.22] | [0.15] | [0.39] |
| Positive gender schooling attitudes z-score [n=1,878] | 0.160 | 0.156* | 0.099 | 0.068 | -0.057 | -0.088 |
| 95% CI | [0.05, 0.27] | [0.31] | [0.25] | [0.21] | [0.10] | [0.06] |

| Education |       |       |       |       |       |       |
|-----------|-------|-------|-------|-------|-------|-------|
| Grade attainment | 4.492 | 0.259** | 0.194* | 0.181* | -0.065 | -0.079 |
| 95% CI | [3.98, 5.01] | [0.42] | [0.36] | [0.35] | [0.10] | [0.09] |
| Primary school complete (=1) | 0.130 | 0.010 | 0.021 | -0.029 | 0.011 | -0.039 |
| 95% CI | [0.05, 0.18] | [0.07] | [0.09] | [0.03] | [0.08] | [0.02] |
| Enrolled in current school year (=1) | 0.808 | 0.144*** | 0.070* | 0.084** | -0.074* | -0.060* |
| 95% CI | [0.74, 0.87] | [0.20] | [0.13] | [0.14] | [-0.02] | [-0.01] |

| Health |       |       |       |       |       |       |
|--------|-------|-------|-------|-------|-------|-------|
| Knows most fertile period during menstrual cycle (=1) [n=1,878] | 0.049 | -0.031† | -0.021 | -0.013 | 0.010 | 0.018 |
| 95% CI | [0.02, 0.08] | [0.00] | [0.01] | [0.02] | [0.03] | [0.04] |
| Knows method of modern contraception (=1) [n=1,848] | 0.390 | -0.097† | -0.103* | -0.096† | -0.007 | 0.001 |
| 95% CI | [0.31, 0.47] | [0.02] | [-0.01] | [0.01] | [0.09] | [0.11] |
| SRH myths knowledge z-score [n=1,400] | 0.000 | 0.344* | 0.433** | 0.234† | 0.090 | -0.110 |
| 95% CI | [-0.20, 0.20] | [0.60] | [0.70] | [0.50] | [0.35] | [0.15] |
| General self-efficacy z-score [n=1,878] | 0.990 | -0.054 | -0.014 | -0.030 | 0.040 | 0.024 |
| 95% CI | [0.86, 1.12] | [0.14] | [0.19] | [0.16] | [0.25] | [0.21] |

| Wealth creation |       |       |       |       |       |       |
|-----------------|-------|-------|-------|-------|-------|-------|
| Financial literacy z-score [n=1,878] | 0.439 | -0.069 | 0.030 | 0.185 | 0.099 | 0.254* |
| 95% CI | [0.25, 0.63] | [-0.31] | [-0.19] | [-0.06] | [-0.08] | [0.04] |
| Household-level outcomes |  |  |  |  |  |  |  |
|--------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Household wealth quintile | 3.226 | -0.434* | -0.247 | -0.211 | 0.188 | 0.223 | 0.035 |
| 95% CI                   | [2.93, 3.52]     | [-0.83, -0.64]  | [-0.54, -0.25]  | [-0.16, -0.34]  |               |               |               |

| Expected girl to complete secondary school (=1) | 0.861 | 0.058* | 0.050† | 0.043 | -0.008 | -0.015 | -0.007 |
| 95% CI | [0.82, 0.91] | [0.01, 0.00] | [-0.01, -0.05] | [-0.06, -0.06] |               |               |               |

| Summary index z-scores |  |  |  |  |  |  |  |
|------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Violence prevention outcomes | 0.000 | 0.030 | -0.101 | 0.104 | -0.131† | 0.073 | 0.205** |
| 95% CI | [-0.15, 0.15] | [-0.29, -0.07] | [-0.29, -0.06] | [-0.06, 0.06] |               |               |               |

| Education outcomes summary | 0.000 | 0.302*** | 0.189* | 0.122 | -0.114 | -0.180* | -0.067 |
| 95% CI | [-0.16, 0.16] | [0.16, 0.02] | [-0.03, -0.29] | [-0.33, -0.25] |               |               |               |

| Health outcomes summary | 0.000 | -0.026 | 0.066 | -0.014 | 0.092 | 0.012 | -0.080 |
| 95% CI | [-0.17, 0.17] | [0.17, 0.26] | [0.19, 0.24] | [0.15, -0.24] |               |               |               |

| Wealth creation outcomes | 0.000 | 0.167 | 0.349* | 2.852*** | 0.182 | 2.686*** | 2.504*** |
| 95% CI | [-0.15, 0.15] | [0.14, 0.66] | [2.14, -0.15] | [1.97, 1.79] |               |               |               |

Notes: The table reports two-year follow-up means for V-only in column 1, the estimated ITT effect for each study arm relative to V-only in columns 2–4 and differences in the estimated ITT effects across study arms in columns 5–7. Column 5 compares the estimates for VEH to VE, column 6 compares VEHW to VE, and column 7 compares VEHW to VEH. For example, the estimate in column 7 for 'Experienced violence by a male in the past year' (-0.037) is the difference between the estimate for VEHW (-0.022) in column 4 and the estimate for VEH (0.015) in column 3. Minor differences in the reported differentials compared to the estimates presented in columns 2–4 are due to rounding. Numbers in square brackets indicate 95% confidence intervals. Regressions were estimated with standard errors clustered at the village level and included controls for 2009 district per the stratified randomization, age and the outcome measured at baseline unless otherwise noted. N = 1,909; sample is smaller for some individual outcomes due to missing data as indicated.

1 No baseline control for outcome variable available.

2 Non-response for one or more items on the scale ranged from 24–30% across study arms and was higher for younger girls.

3 Violence prevention indicator reverse coded prior to inclusion in summary variable.

*** p<0.001, ** p<0.01, * p<0.05, † p<0.1
Discussion

Taken together, the results support the hypothesis that a multi-sectoral approach is needed to improve different outcomes important to the well-being of young adolescent girls across multiple domains, including education, health, and financial practices. Examining the summary variables, in Kibera VEH improved only the health summary, whereas VEHW improved the education, health and wealth creation summary variables. In Wajir, the VE and VEH arms improved education and but VEHW improved wealth creation. Hence for the most part the sector-specific intervention components typically directly contributed to the outcomes within their domain (or the summary measure) with only minimal impacts on specific sector outcomes in study arms without the specific sector intervention. For example, education conditional cash transfers alone (the VE study arm) had no or only small effects on the health and wealth creation outcomes examined. Rather, the education intervention improved educational outcomes, the health intervention increased health knowledge (in Kibera only) and the wealth creation intervention increased financial literacy and savings behavior. Longer-term follow up will determine whether improvements in these intermediate outcomes will delay childbearing, the primary outcome of the AGI-K study.

This paper contributes to the literature on cash versus cash-plus programming. The empowerment components of the intervention (group sessions focused on health and financial literacy) led to positive changes for a subset of outcomes that cash alone did not influence. The findings are consistent with related literature that cash alone is not a “magic bullet” because it does not influence all potentially important outcomes [40], although it remains a key component of the combination of interventions needed to address the array of challenges facing adolescents during their transition to adulthood. The cash transfer appears to have been critical in this context in part because it addressed the economic constraints at the household level, while also incentivizing education for the girls. This is in line with other studies in which girls empowerment programming took place without an education cash transfer and for which there were neither short nor long-term benefits on school enrollment [16]. Therefore, policy makers and program implementers may consider coupling cash transfer programs meant to improve adolescent programs with additional activities aimed at improving knowledge and skills in relevant sectors such as health or financial literacy.

The two distinct sites also provide important new examples in which context and cultural norms moderate the effectiveness of an intervention, even after it has been carefully tailored to different settings. While in general impacts were similar at a sectoral level in both Kibera and Wajir, suggesting a degree of external validity to different contexts, the specific indicators affected differed across the sites. For example, in Kibera the education conditional cash transfer did not improve enrollment but in the VEHW improved primary school completion and the transition to secondary school for girls who had been
in their final two years of primary school at baseline, whereas in Wajir the intervention largely worked to
get girls who were not in school at baseline to enroll, in most cases for the first time. This is almost
certainly due to the differences in schooling at baseline—with 99% of girls enrolled and 72% studying at
the appropriate grade level for their age in Kibera compared to only 73% and 24% in Wajir. Only in Wajir
was there an increase in the household expectation the girl would complete secondary school, because
they were already nearly 100% in Kibera. In both settings, impacts on educational outcomes were often
modestly smaller in the VEH and VEHW study arms compared to VE, possibly due to the additional
complexity and burden of implementing and participating in those arms relative to VE. This points to a
possible trade-off between the type of intervention that would achieve the largest results on one specific
outcome versus a more complex intervention that would achieve results across a wider set of outcomes,
albeit with possibly smaller effect sizes. The health intervention led to SRH knowledge increases in
Kibera, but not in Wajir. We hypothesize that this is possibly because of the inexperience of mentors or
discomfort they felt in Wajir when delivering SRH content, particularly around contraception. Context also
may have important implications for the longer-term outcomes related to these interventions, and it is
likely that differing context and cultural norms will continue to influence the pathways through which
other outcomes are achieved, particularly with respect to eventual marriage and fertility decisions.

This paper has several limitations. The main limitation is that there is no randomized control and we
cannot isolate the effect of the violence prevention intervention. Although violence prevention broadly
conceived is critical in the socioecological model [15] and to the theory of change underpinning the
interventions, we are unable to assess empirically how important it was to include a community-level
intervention focused on changing norms to increase the value of girls. Second, we did not implement the
health or wealth creation interventions on their own or together without the education component (with its
conditional cash transfers), so it is not possible to assess the effectiveness of programming only focused
on empowering the girls. Third, girls randomized to the health and wealth interventions which included
attendance at weekly meetings had different levels of participation and thus different exposures to the
interventions; all estimates presented are ITT. Fourth, in Kibera (but not Wajir because of the distances
between clusters) there was the possibility of small spillover effects between girls randomized to
different arms but living near one another and overlap of girls in each study arm within schools was
proportional to the randomization. Because enrollment was nearly universal at baseline, however, there
were only small increases in enrollment so it was unlikely they substantively increased school crowding
or depressed enrollment for girls in the V-only arm. On the other hand, although the bulk of the transfers
were delivered to the schools directly, girls receiving transfers could share resources and information with
those not receiving them or serve as positive role models, leading to positive spillovers and consequently
more conservative point estimates of program impact. Finally, as the girls in the sample were still
relatively young at the two-year follow-up, we do not have the statistical power to test the impact on
longer-term outcomes such as secondary school completion, timing of sexual debut, first pregnancy or
marriage. This limitation also means we do not consider cost-effectiveness of the interventions as they
would necessarily be only partial in nature at this juncture. These outcomes will be the focus using data
collected two years after the end of the intervention.
Offsetting these limitations, this paper has several strengths, including a rigorous randomized research design implemented in two different settings, high participation with virtually no program contamination in the form of girls receiving interventions they were not randomized to, high two-year follow-up rates and measurements on both the adolescent girl and her household.

Conclusions

This paper contributes to the growing literature on multi-sectoral programming for adolescent girls and the cash versus cash plus debate. The findings reinforce the premise that addressing empowerment for adolescent girls through a multi-sectoral approach can lead to broader impacts and that cash plus, i.e., supplementing economic resources for the household with social, health and asset-building skills for the girls themselves, can provide a wider range of beneficial impacts for them across education, health and economic outcomes. Program and policy design should consider opportunities to leverage or combine social protection at the household level with individual programs for the girls in those households to increase the benefits for adolescent girls.

Abbreviations

AGI-K
Adolescent Girls Initiative–Kenya
ANCOVA
Analysis of Co-Variance
CCT
Conditional Cash Transfer
FDR
False Discovery Rate
ITT
Intent-to-Treat
KDHS
Kenya Demographic and Health Survey
NCSSS
Nairobi Cross-Sectional Slum Survey
PCA
Principal Components Analysis
NGO
Non-governmental Organization
SD
Standard Deviation
SRH
Sexual and Reproductive Health
Declarations

**Ethics approval and consent to participate**

The study was approved by the Population Council Institutional Review Board (IRB) (p661) and the AMREF Ethics and Scientific Review Committee (p143-2014). In addition, research permits were obtained from the Kenyan National Council on Science, Technology and Innovation (P/18/6952/25330). Written informed consent was obtained from a parent or guardian age 18 or over and oral assent for girls (all of whom were under 18 at the two-year follow-up). All methods were carried out in accordance with relevant ethical guidelines and regulations outlined in the Declaration of Helsinki.

**Consent for publication**

Not Applicable

**Availability of data and materials**

Study data in this paper, including de-identified individual data and data dictionary, will be made available open access upon publication. The data will be stored and available for downloading via the Adolescent Data Hub - [http://popcouncil.org/girlcenter/adolescentdatahub/](http://popcouncil.org/girlcenter/adolescentdatahub/).

**Competing Interests**

The authors declare that they have no competing interest

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**Author’s Contributions**

KA, JM, ESH and BA designed and conceptualized the study. ESH, JM and BK conducted the data analysis. KA, JM, ESH and BK drafted the manuscript. All authors reviewed and commented on the manuscript.

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**Figures**

**Figure 1**

**Theory of Change**
| Intervention arm         | Key components                                                                                                                                 |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Violence prevention     | Community conversations and contracts  
- Group of key stakeholders formed in each village  
- Bi-monthly discussions on improving the situation for girls in the community  
- Development and implementation of action plan (budget allocations $1500-2000) |
| Education               | Conditional cash and in-kind transfers  
- Two cash transfers to household head per term (totaling ~$11 in Kibera and ~$15 in Wajir); first transfer upon enrollment; second upon verified continued attendance  
- School supply kit for girl upon enrollment each term (value ~$6)  
- Portion of school fees paid to school upon enrollment each term (~$7 for primary and ~$60 for secondary)  
- Incentive to school upon enrollment each term, ~$5 for each AGI-K girl enrolled |
| Health                  | Girls group meetings covering health and life skills (HLS) curriculum  
- Led by female mentor from the community  
- 20-25 girls per group meeting weekly  
- 47 sessions in HLS curriculum in Kibera  
- 36 sessions in HLS curriculum in Wajir |
| Wealth creation         | Financial literacy and savings activities  
- 19 session financial literacy curriculum integrated into girls groups described above  
- Kibera: facilitated to open savings account  
- Wajir: given home banks  
- Annual savings incentive: ~$3 |

**Figure 2**

Intervention Summary
Figure 3a. Kibera Individual Sample Flow

- Girls ages 10-13 initially identified for eligibility (n=3534)
- Excluded out of age 11-14 age range (n=363)
- Girls ages 11-14 processed for eligibility (n=3171)
- Excluded ineligible (not permanent resident, boarding school) (n=641)
- Initial sample girls 11-14 processed eligible (n=2529)
- Excluded children, also randomly selecting one girl per household (n=446)

Sample of girls ages 11-14 by random allocation (n=1260)

| Status | VE | VEHE | VEHEP | Total |
|--------|----|------|-------|-------|
| Selection sample assessed for eligibility, n | 524 | 824 | 824 | 3298 |
| Further excluded ineligible based on age, permanent residence, n | 187 | 191 | 174 | 556 |
| Total | 701 | 1015 | 998 | 3854 |

Baseline survey (February-April 2013)

- Sample target sample, n 617 625 625 2517
- Sample non-response, % 6.3 6.5 6.3 6.3
- Sample completed, n 597 610 609 2500

Two year follow-up survey (June-July 2015)

- Two-year follow-up target sample, n 599 602 602 2303
- Two-year loss to follow-up, % 15.3 5.2 6.6 6.6
- Reasons for loss to follow-up:
  - Died, n 0 0 0 0
  - Rejected, n 0 0 15 15
  - Not located, n 8 4 23 29
  - Other inforamation, n 9 8 6 18
- Two-year follow-up completed, n 507 561 569 2303

\* If the first randomly selected girl was determined ineligible, an eligible sister was substituted in her place.

\* The baseline completed sample was the target sample at two-year follow-up.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Annex117Nov2020.docx