The effect of a conditional cash transfer for HIV prevention on the experience of partner violence for young women: Evidence from a randomized experiment in South Africa HPTN 068

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Abstract

**Background:** Evidence has shown that the experience of violence by a partner has important influences on women’s risk of HIV acquisition. Conditional cash transfers (CCTs) targeted to young women in sub-Saharan Africa have been advocated as an intervention to reduce the risk of HIV-infection, but the success of such interventions may be conditional upon changes in gendered power inequalities. Using a randomized experiment in northeast South Africa, we find that a CCT targeted to poor girls in high school reduced the risk of physical intimate partner violence (IPV) in the past 12 months by 34%. The purpose of this analysis is to understand the pathways through which the CCT affects IPV.

**Methods:** HPTN 068 was a phase 3, randomized controlled trial in rural Mpumalanga province, South Africa. Eligible young women (aged 13-20) and their parents or guardians were randomly assigned (1:1) to either receive a monthly cash transfer conditional on monthly high school attendance or no cash transfer. Between 2011 and 2015, participants (N=2,448) were interviewed at baseline, then at annual follow-up visits at 12, 24, and 36 months. The total effect of the CCT on IPV was estimated using a GEE log-binomial regression model. We then estimated controlled direct effects to examine mediation of direct effects through intermediate pathways. Mediators include sexual partnership measures, the sexual relationship power scale, and household consumption measures.

**Results:** We found evidence that the CCT works in part through delaying sexual debut or reducing the number of sexual partners. The intervention interacts with these mediators leading to larger reductions in IPV risk compared to the direct effect of the CCT on any physical IPV [RR 0.66, CI(95%):0.59-0.74]. The largest reductions are seen when we estimate the controlled direct effect under no sexual debut [RR 0.57, CI(95%):0.48-0.65] or under no sexual partner in the last 12 months [RR 0.53, CI(95%):0.46-0.60].

**Conclusion:** Results indicate that a CCT for adolescent school girls has protective effects on their experience of IPV and that the effect is due in part to girls choosing not to engage in sexual partnerships, thereby reducing the opportunity for IPV. Since these behaviours also protect against HIV acquisition, this evidence strengthens the case for CCTs for HIV prevention.

This study is registered at ClinicalTrials.gov (NCT01233531).
Introduction

Violence against women, and specifically intimate partner violence (IPV), is a major global public health problem, causing significant morbidity and mortality worldwide [1]. Around a third of women globally have experienced IPV [2] and South Africa, the location of this study, is no exception [3-4]. Partner violence in South Africa is particularly a problem for young women, putting them at risk for sexual and reproductive health issues including HIV infection [5]. IPV can be a direct cause of HIV transmission through forced or coercive sex with a HIV-positive male but can also indirectly lead to HIV transmission by limiting young women’s ability to negotiate and practice safe sexual behaviours such as using condoms [5-7]. Moreover, poverty can exacerbate young women’s risk for both IPV and HIV as it often heightens this gendered power imbalance by pressuring young women to engage in transactional sex [7-9]. Given the critical intersections of HIV and IPV, the success of HIV prevention interventions may be conditional upon changes in gendered power inequalities.

The global development agenda, articulated in the United Nations Sustainable Development Goals (SDGs), has explicitly recognized the importance of addressing these interconnections—those among health, gender inequalities, and poverty—to progress peace and prosperity for all. In addition to promoting good health (SDG 3), our study, HIV Prevention Trial Network (HPTN) 068, helps to address these intersected issues with particular connections to goals to end poverty (SDG 1), to achieve gender equality and empower all women (SDG 5), to promote peaceful societies (SDG 16), and to ensure equitable, quality education (SDG 4). HPTN 068, an experimental intervention for HIV prevention, provided a conditional cash transfer (CCT) to young women attending high school and their households in poor, rural South Africa. In addition to the economic benefits of cash transfers, there is some evidence to suggest that cash transfers may be an effective vehicle for empowering women and lead to improved sexual behaviours [10-13]. Moreover, education can be empowering for women, and so providing the cash conditional on school attendance may be an important mechanism for reducing young women’s vulnerability to HIV and IPV [13-18].

We found that the CCT had no significant effect on HIV incidence but did reduce the young
women’s risk of IPV by 34 percent [18]. While similar evidence has been found in other studies of cash transfers [19-24], most evidence comes from Latin America and focuses on older women. Moreover, little is known about how these programs work to prevent IPV [24]. In this paper, we investigate the causal pathways through which a CCT intervention targeted to young women in South Africa works to reduce IPV; concentrating on perceived empowerment, sexual behaviours, and economic well-being.

**Methods**

**Study Site and Design**

The HPTN 068 study site is in the Mpumalanga province in northeast South Africa. Villages in our study are located within the Agincourt Health and Socio-Demographic Surveillance Systems (AHDSS) catchment area—a rural but densely populated and characterised by high poverty [25]. A 2010 population-based HIV prevalence survey undertaken in Agincourt found peak HIV prevalence to be in those aged 35-39, with women having a slightly higher rate (46.1%) than men (45.3%) [Gomez 2013]. Moreover, there is high HIV prevalence amongst young women of similar age to our study sample—5.5% among 15-19 year olds and 27% among 20-24 year olds [26].

The study was designed as a phase III randomized control trial to test the effectiveness of CCTs for HIV prevention among young women (aged 13-20) attending high school. Enrolled participants were randomly assigned to the treatment arm, and they and their parents or guardians received monthly cash transfers of 100 and 200 Rand (R) respectively (or roughly US$ 10 and US$ 20 using 2012 the conversion rates). Baseline per capita household expenditure was R295 so transfer amounts made up a significant proportion of pre-program consumption.¹ For both the young woman and the parent or guardian, transfer funds were deposited directly into respective bank accounts. Cash transfers were conditional on the young woman attending at least 80% of school days during the month. As long as the young woman was eligible to be in school and met the attendance criteria, she could receive the transfer for up to 3 years.

¹ The total amount of R300 was chosen because it was on par with the R280 that the Child Support Grant, South Africa’s flagship social protection program, provided for children under 18 years in 2012.
Eligibility and Randomization

To be eligible for the study, young women had to be aged 13-20 years and enrolled in a participating high school (grades 8, 9, 10, or 11) in the study location. They also had to be unmarried, not pregnant, able to read, living with at least one parent or guardian, willing to take an HIV and herpes simplex virus (HSV)-2 test, and have or be able to open a bank account (or post office account). Between March 2011 and December 2012, 10,134 young women were screened from the ADHSS population, and 2,537 were found eligible and enrolled [27]. After young women were recruited to the study, participants completed an Audio Computer-Assisted Self-Interview (ACASI) and HIV and HSV-2 testing, which included pre and post-test HIV counselling. After baseline assessments, young women (and their parent or guardian) were individually randomized (1:1) to either the treatment group (monthly cash transfer conditional on school attendance) or control group (no cash). All participants were then reassessed annually at 12, 24, and 36 months until they graduated from high school or the study ended, whichever came first. Each visit included the ACASI, HIV and HSV-2 testing (if negative at the previous visit), and HIV pre-test and post-test counselling. Institutional Review Board approval for this study was obtained from the University of North Carolina at Chapel Hill and the University of the Witwatersrand Human Research Ethics Committee as well as the Provincial Department of Health’s Research Ethics Committee.

Measures

The ACASI asked respondents about sexual and physical IPV experiences regardless of whether they reported having a sexual partner. ‘Any sexual IPV’ is an indicator for whether a girl reported that she was physically forced to have sex when she did not want to in the last 12 months. ‘Any physical IPV’ is an indicator for any experience of physical intimate partner violence in the last 12 months as defined by the WHO [2];

Has a partner (responses are yes or no):

1. Slapped you or thrown something at you that could hurt you?
2. Pushed you or shoved you?
3. Hit you with a fist or with something else that could hurt?
4. Kicked you, dragged you, or beaten you up?
5. Choked or burnt you on purpose?
6. Threatened to use or actually used a gun, knife, or other weapon against you?

We also created indicators for moderate and severe IPV as defined by the WHO, where moderate IPV indicates any experience of violence from items 1 or 2 and severe IPV indicates any experience of violence from items 3-6. Variables are not mutually exclusive; young women could experience both moderate and severe IPV.

Mediation pathways we examined included sexual behaviour, perceived sexual empowerment, and household economic well-being. We chose to explore these variables based on hypothesized conceptual pathways through which the cash transfer might reduce IPV [24]. Sexual behaviour measures included an indicator for sexual debut (vaginal or anal) after baseline, an indicator for whether the girl had any sexual partners in the past 12 months, and the number of sexual partners in the last 12 months. Sexual empowerment was defined only for young women that reported ever having had sex and operationalized with the Sexual Relationship Power Scale (SRPS)[28-29]. We looked at the continuous scale (higher scores indicate greater perceived empowerment) and similar to other studies that use the SRPS, we split the scale into terciles based on scores from all waves. Economic measures included per capita household expenditure (in logarithms) and an indicator for being in the top quartile of per capita household expenditure.

**Analysis Methods**

We began analysis with an intention to treat (ITT) analysis of the total effect of the CCT on IPV measure for all participants with an HIV negative status at baseline. Outcomes are modelled using a generalized estimating equation (GEE) model to account for repeated measures on participants. We estimate risk ratios using a binomial distribution and log link with robust variance. Next, we estimated the direct treatment effects on potential mediators using GEE models and robust variance. Sexual debut was modelled using a discrete time survival analysis. Risk ratios are estimated for binary (and count) mediators and coefficient estimates are provided for continuous mediator variables (SRPS and log per capita expenditure). All models control for participant’s age at baseline. Only mediators that are significantly impacted by treatment and that have a baseline relationship with IPV are considered for mediation analysis.
To explore mediation of the effect of the CCT on IPV, we used the causal mediation approach [30-32]. We estimated the controlled direct effect (CDE) of the CCT, which expresses the effect of keeping the mediator controlled at level M for everyone but switching exposure from control, Y(0), to treatment, Y(1).

\[ CDE(M) = E[Y(1,M)] - E[Y(0,M)] \]

In general, CDEs are used to estimate what the difference in the effect of the exposure would be if you could impose a mediator intervention. In our study, CDEs represent the hypothetical risk reduction if we were able to set our mediators at a more protective level (e.g., reducing sexual partners).

We estimated the CDE using the parametric g-formula [33]. In the first step, we fit log-binomial models for the effect of CCT on IPV at each time point, including terms for each mediator, treatment-mediator interactions, and baseline levels of confounders (see online appendix for details). We then used the coefficients from this model to estimate the predicted probabilities of the outcome under each hypothetical intervention on the exposure (treatment or control) and mediator. We report risk ratios for each contrast of interest as the ratio of the average predicted outcome probability under each hypothetical intervention compared. Standard errors of the risk ratios were estimated as the standard deviation of the point estimate from 5000 bootstrap samples of the observed data [34].

**Results**

**Baseline Data**

Baseline descriptive statistics for study participants (total and by study arm) are provided in Table 1. We exclude baseline HIV positive or unknown cases (N=85) from our analysis leaving a baseline sample of 2,448 HIV negative young women. All young women participating in the study were South African and of black race/ethnicity. Young women had a median age of 15 years (IQR 14–17) and were distributed equally across all school grades (8–11). All demographic and outcome variables in Table 1 were tested for baseline balance and we found no significant differences in means between study arms at the 10 percent significance level. Additionally, the
study arms were also balanced on other key behavioural outcomes, including the main outcomes of HIV and HSV-2 infection status [18].

Table 1. Baseline demographics and outcomes for young women study participants by treatment arm

<table>
<thead>
<tr>
<th></th>
<th>Total (n=2,448)</th>
<th>Treatment group (n=1,225)</th>
<th>Control group (n=1,223)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N (%) or Median (IQR)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>15 (14 to 17)</td>
<td>15 (14 to 17)</td>
<td>15 (14 to 16)</td>
</tr>
<tr>
<td>School grade enrolment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 8</td>
<td>614 (25%)</td>
<td>310 (25%)</td>
<td>304 (25%)</td>
</tr>
<tr>
<td>Grade 9</td>
<td>669 (27%)</td>
<td>321 (26%)</td>
<td>348 (28%)</td>
</tr>
<tr>
<td>Grade 10</td>
<td>677 (28%)</td>
<td>347 (28%)</td>
<td>330 (27%)</td>
</tr>
<tr>
<td>Grade 11</td>
<td>488 (20%)</td>
<td>247 (20%)</td>
<td>241 (20%)</td>
</tr>
<tr>
<td>Ever physical IPV</td>
<td>415 (17%)</td>
<td>219 (18%)</td>
<td>196 (16%)</td>
</tr>
<tr>
<td>Ever sexual IPV</td>
<td>108 (4.5%)</td>
<td>46 (3.8%)</td>
<td>62 (5.1%)</td>
</tr>
<tr>
<td>Any physical IPV in past 12 months</td>
<td>254 (11%)</td>
<td>136 (11%)</td>
<td>118 (10%)</td>
</tr>
<tr>
<td>Ever vaginal or anal sex</td>
<td>649 (27%)</td>
<td>324 (26%)</td>
<td>325 (27%)</td>
</tr>
<tr>
<td>Any sexual partner in past 12 months</td>
<td>645 (27%)</td>
<td>316 (26%)</td>
<td>329 (27%)</td>
</tr>
<tr>
<td>Number of sexual partners in past 12 months</td>
<td>1,773 (73%)</td>
<td>893 (74%)</td>
<td>880 (73%)</td>
</tr>
<tr>
<td>0 partners</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 partner</td>
<td>504 (21%)</td>
<td>247 (20%)</td>
<td>257 (21%)</td>
</tr>
<tr>
<td>&gt;=2 partners</td>
<td>141 (6%)</td>
<td>69 (6%)</td>
<td>72 (6%)</td>
</tr>
<tr>
<td>Sexual Relationship Power Scale¹ (SRPS)</td>
<td>28 (23 to 32)</td>
<td>28 (23 to 32)</td>
<td>29 (24 to 32)</td>
</tr>
<tr>
<td>Highest tercile SRPS (34-36)</td>
<td>132/653 (20%)</td>
<td>70/324 (22%)</td>
<td>62/329 (19%)</td>
</tr>
<tr>
<td>Log PC Expenditure (2.9-9.7)</td>
<td>5.7 (5.2 to 6.2)</td>
<td>5.7 (5.2 to 6.2)</td>
<td>5.7 (5.2 to 6.2)</td>
</tr>
</tbody>
</table>

Notes: No significant differences (p-value<0.1) found between treatment and control outcomes at baseline.

¹SRPS is only reported for girls who had been sexually active (n=697), scale range is from 1 to 36 with higher scores representing greater empowerment

At baseline, 17 percent of all young women in the study reported ever having experienced physical IPV by a partner and 11 percent had experienced some form of physical IPV in the past 12 months. The majority of study participants were not sexually active at baseline, only 27 percent reported ever having had sex (vaginal or anal). Additionally, only around 4 percent had ever experienced sexual IPV.

Table 2 shows ITT program impacts on all IPV outcomes including the main effects of whether a participant experienced any sexual IPV (row 1) and physical IPV (row 2) in the past 12 months. We found no effect on sexual IPV, but, as reported in the Lancet [18], the program resulted in a
significant reduction in physical IPV. Young women in the treatment group have a 34 percent lower risk of IPV (RR 0.66), significant at the 0.1 percent level.

Table 2. Intent to Treat Impacts of the CCT on IPV among young women enrolled in HPTN 068

<table>
<thead>
<tr>
<th></th>
<th>Treatment (N=1214)</th>
<th>Control (N=1114)</th>
<th>Risk Ratio (95% CI)</th>
<th>Observations¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Sexual IPV</td>
<td>256 (10.0%)</td>
<td>209 (9%)</td>
<td>0.96 (0.78 - 1.20)</td>
<td>4,872</td>
</tr>
<tr>
<td>Any Physical IPV</td>
<td>473 (18.5%)</td>
<td>636 (27.8%)</td>
<td>0.66*** (0.59 - 0.74)</td>
<td>4,849</td>
</tr>
<tr>
<td><strong>Individual Items</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slapped or threw something</td>
<td>377 (14.7%)</td>
<td>519 (22.6%)</td>
<td>0.65*** (0.57 - 0.74)</td>
<td>4,859</td>
</tr>
<tr>
<td>Pushed or shoved</td>
<td>282 (11.0%)</td>
<td>391 (17.1%)</td>
<td>0.64*** (0.56 - 0.74)</td>
<td>4,856</td>
</tr>
<tr>
<td>Hit with fist/ another item</td>
<td>203 (7.9%)</td>
<td>309 (13.5%)</td>
<td>0.59*** (0.50 - 0.69)</td>
<td>4,857</td>
</tr>
<tr>
<td>Kicked, dragged, or beaten up</td>
<td>198 (7.7%)</td>
<td>272 (11.9%)</td>
<td>0.65*** (0.54 - 0.78)</td>
<td>4,855</td>
</tr>
<tr>
<td>Choked or burnt</td>
<td>148 (5.8%)</td>
<td>222 (9.7%)</td>
<td>0.60*** (0.48 - 0.73)</td>
<td>4,854</td>
</tr>
<tr>
<td>Threatened or used gun/ another weapon</td>
<td>140 (5.5%)</td>
<td>205 (8.9%)</td>
<td>0.61*** (0.49 - 0.75)</td>
<td>4,856</td>
</tr>
<tr>
<td><strong>Severity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>445 (17.4%)</td>
<td>591 (25.8%)</td>
<td>0.67*** (0.60 - 0.75)</td>
<td>4,849</td>
</tr>
<tr>
<td>Severe</td>
<td>260 (10.2%)</td>
<td>367 (16.0%)</td>
<td>0.63*** (0.54 - 0.74)</td>
<td>4,849</td>
</tr>
</tbody>
</table>

Notes: Adjusted for age; ¹pvalue<0.10, *pvalue<0.05, **pvalue<0.01, ***pvalue<0.001
¹Observations over the study period, out of total N of 2,302 girls followed for at least one visit after baseline

Below the main treatment effects, we break down the effect on any physical IPV into its component parts. For each of these six acts of partner violence, young women in the treatment arm are significantly less likely (p-value<0.001) to report experiencing that type of violence in the past 12 months. Risk ratios for each indicator are similar to the overall impact (ranging from 0.59-0.65). Additionally, we tested whether the program affected the severity of violence, by separating moderate and severe IPV at the bottom of Table 1. Results are robust to this categorization and we find strongly significant effects for both moderate and severe IPV.
Earlier we described the potential pathways we examined related to sexual partnerships, empowerment, and economic well-being to explain the effect of the CCT on reducing risk of IPV.

**Table 3. ITT Impacts of the CCT on Hypothesized Mediators among young women enrolled in HPTN 068**

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Treatment N (%) or Median (IQR)</th>
<th>Control N (%) or Median (IQR)</th>
<th>RR or coefficient (95% CI)</th>
<th>Observations (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sexual Debut¹,²</td>
<td>239 (14%)</td>
<td>246 (16%)</td>
<td>RR 0.82* (0.69 - 0.96)</td>
<td>3,266 (1,589)</td>
</tr>
<tr>
<td>Number of sexual partners in the last 12 months</td>
<td>0.41 (0.69)</td>
<td>0.46 (0.73)</td>
<td>RR 0.87* (0.79 - 0.97)</td>
<td>4,869 (2,294)</td>
</tr>
<tr>
<td>Any sexual partner in last 12 months</td>
<td>841 (33%)</td>
<td>824 (36%)</td>
<td>RR 0.91* (0.83 - 0.99)</td>
<td>4,869 (2,294)</td>
</tr>
<tr>
<td>Over one sexual partner in last 12 months</td>
<td>147 (7%)</td>
<td>149 (6%)</td>
<td>RR 0.86 (0.68 - 1.09)</td>
<td>4,869 (2,294)</td>
</tr>
<tr>
<td>SRPS³,⁴</td>
<td>28.5 (25-34)</td>
<td>28.5 (25-34)</td>
<td>Coef. 0.06 (-0.63 - 0.75)</td>
<td>1,852 (1,195)</td>
</tr>
<tr>
<td>High SRPS³,⁴</td>
<td>264 (31%)</td>
<td>238 (28%)</td>
<td>RR 1.12 (0.96 - 1.30)</td>
<td>1,852 (1,195)</td>
</tr>
<tr>
<td>Log Per Capita Expenditure</td>
<td>6.0 (IQR: 5.6-6.4)</td>
<td>6.0 (IQR: 5.5-6.3)</td>
<td>Coef. 0.03 (-0.02 - 0.08)</td>
<td>4,873 (2,294)</td>
</tr>
<tr>
<td>Top quartile Per Capita Expenditure</td>
<td>670 (26%)</td>
<td>552 (24%)</td>
<td>RR 1.09 (0.97 - 1.22)</td>
<td>4,873 (2,294)</td>
</tr>
</tbody>
</table>

Notes: Adjusted for age; ¹Among those who had not debuted before baseline ²Per person-visit (cumulative risk) ³Sexual Relationship Power Scale, scores ranges from 1-36 ⁴Only girls that reported having sex either at some point at that visit or before, or if she reported having a partner after being asked IPV questions ⁵High SRPS is top tercile (>=34) and compared to low or moderate SRPS score.  *pvalue<0.10, *pvalue<0.05, **pvalue<0.01, ***pvalue<0.001

As a necessary condition for mediation we should find that the CCT directly impacts these pathways. In accordance with results reported in the Lancet [18], we found that the intervention does not reduce the likelihood that young women sexually debuted over the entire study period. However, Table 3 shows that the CCT appears to have a cumulative, protective effect on sexual debut (RR 0.82) significant at the 95% CI level (Table 3). In other words, excluding young women that have ever had sex at baseline or at the prior visit, there is a reduced risk of sexual debut for young women in the treatment arm.

Additionally, the program had a positive effect of reducing sexual partnerships during the study. Since partner number is a count variable and most sexually active girls had only one partner we estimated the incident rate ratio and find that being in the intervention resulted in a significantly
lower risk of having an additional partner (IRR 0.87). Similarly, participants in the treatment arm had a 9 percent lower risk of having any sexual partner in the last 12 months.

In addition, we examined the effect of CCT on young women’ perceived empowerment using the SRPS. Since only young women that reported having sexual partnerships have SRPS scores, our sample is reduced considerably (Table 3). We found no significant effect of the CCT intervention on either the continuous SRPS scale or the likelihood of scoring in the top tercile (a score of 34 or greater). Lastly, we found no effect of the CCT on logged per capita household expenditure or on the likelihood of being in the top quartile of per capita expenditure.

To examine causal mediation of the CCT on IPV, we used the three measures that were significantly affected by treatment (sexual debut, any sexual partner, and number of sexual partners). Since treatment effects in Table 2 are robust to different specifications of IPV, we used any IPV as our key outcome to analyse mediation. Using the G-computation formula for mediation, we estimated the CDE for each mediator-outcome pair (Table 4). For each mediator intervention defined in the left column, we show the CDE broken into the absolute risk of IPV (for each arm) and the risk ratio.

Table 4. Controlled direct effects of mediator interventions on physical IPV using parametric G-computation formula

<table>
<thead>
<tr>
<th>Mediator Intervention</th>
<th>Risk (%)</th>
<th>Risk Ratio</th>
<th>No Mediator Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(T=treatment C=control)</td>
<td>Risk Ratio [95% CI]</td>
<td></td>
</tr>
<tr>
<td>No sexual debut</td>
<td>T= 14.8</td>
<td>0.57</td>
<td>C= 26.2</td>
</tr>
<tr>
<td></td>
<td>C= 26.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No sexual partner (past 12 months)</td>
<td>T= 14.8</td>
<td>0.53</td>
<td>C= 27.9</td>
</tr>
<tr>
<td></td>
<td>C= 27.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce sexual partners by one (past 12 months)</td>
<td>T= 16.2</td>
<td>0.59</td>
<td>C= 27.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Adjusted for age and baseline level of mediator. Binary outcomes estimated using a GEE log-linear model and robust variance. Number of sexual partners estimated using a linear regression model with standard errors clustered at the individual level. Effects estimated from Monte Carlo sample (N=5,000) with 95% CIs calculated from standard deviations of point estimates.
Compared to total effect of RR 0.66 (shown in the last column), we find that each mediator intervention additionally lowered the risk of IPV for young women in treatment. The first mediator intervention sets all young women to no sexual debut after baseline resulting in a RR of 0.57, approximately 9 percentage points lower than the total effect. The second row shows the effect of setting all young women in the study to having no sexual partner. This intervention results in the smallest risk ratio (0.54), which is more than 10 percentage points lower than the original total effect. In the last row, we tested a less restrictive mediation scenario by reducing sexual partnerships by 1 (for all those with 1 or more partners). This also reduced the risk of IPV by 7 percentage points (RR 0.59) from total effect. Moreover, for each mediator intervention, we see that the absolute risk of IPV is lower for young women in the treatment group compared to the original risk in the right-hand column (18.5 percent). For young women in the control group, however, the risk is about the same as the original (27.8 percent). Therefore, the interaction of the mediator and treatment is driving the result—intervening on the mediator works to reduce risk of IPV only in combination with the CCT.

**Discussion**

This study found that a cash transfer intervention given to young women in South Africa conditional on school attendance can reduce the risk of physical partner violence. Significant effects were found for all types of physical violence; however, no effect was found for sexual violence. Our findings also indicate that while the intervention had a strong direct effect on physical IPV, it also helped by keeping young women out of sexual partnerships. The CCT had significant direct impact on sexual partnerships including sexual debut\(^2\), any partner in the last 12 months, and number of partners in the last 12 months. Using the G-formula for mediation analysis we estimated CDEs for each of these mediation pathways, setting mediator values to a more protective level for everyone. Results show that under mediator intervention, the risk of physical IPV is reduced compared to the total treatment effect indicating that the CCT intervention interacts with these mediators in a significant way to lower the risk of IPV. While CDE estimates are hypothetical effects, they provide insight into how mediators work and they

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\(^2\) Although the recent follow-up paper in the Lancet [18] reports no effect on sexual debut throughout the whole study, we do find a cumulative reduction in risk when looking at those who had not debuted at each visit.
have the potential to inform policy about how complementary interventions might work using observed effects [35].

Our evidence adds to the growing body of literature showing that CCTs can reduce the risk of IPV [19-24]. However, whereas the current evidence focuses on older women who are married or cohabiting with their intimate partner, our study provides new evidence on the effect for adolescent girls and young women still living at home and attending school. These results are particularly important for young women as they highlight the ability of cash transfers to address the critical intersections between sexual health, poverty, and female empowerment. Developmentally, this maybe important for adolescents’ successful transition into adulthood since for most of these young women this is their first relationship, thus setting patterns for experiencing IPV in future relationships. Additionally, our results are important because there was concern that the cash could lead to more conflict within relationships and increase risk of IPV. Instead, we provide evidence for the supporting role that economic interventions can have on young women’s risk of IPV and potential effect on HIV transmission given the critical intersections of the two.

Despite our finding that the CCT reduced risky sexual behaviours and the link between IPV and HIV in South Africa [5], the CCT intervention did not lead to a parallel reduction in new HIV infections [18]. A likely reason is that the intervention did not lead to differential rates of school attendance between treatment and control groups—it was very high for both groups—and that schooling itself has a protective effect on HIV. Indeed, the study found school attendance itself had a significant effect on HIV incidence [18]. It is also possible that the reductions in sexual debut and partner number were not enough to affect HIV incidence (or to enable discernible differences in incidence) given fairly low rates in both arms during the trial. This is also true for sexual IPV—sexual violence was much less prevalent compared to physical violence at baseline, which could help explain the null findings.

The limitations of this study are primarily restrictions of the data. Besides the inability to link impacts on IPV to HIV incidence, our analysis of mediation pathways could be improved with better measures. For one, the SRPS is only available for women who reported ever having sex.
Unlike evidence from other studies linking reductions in IPV to relationship power dynamic changes [22], the CCT does not seem to have an impact on sexual relationship power within current relationships. This may again speak to the point that young women are choosing to not engage in any sexual relationships (which itself could be the ultimate form of sexual relationship power). However, since most young women were still in school and living at home, not cohabiting with partners, potential impacts in an older, married or largely cohabiting population may be different. A more universal measure of empowerment could improve our understanding of how the intervention affects young women’ attitudes and decision-making. Additionally, economic well-being likely plays a role in some way since the direct effect of the program on IPV is so strong. Our measure of economic well-being is at the household level though, so a better measure might be one that captures individual economic independence and financial empowerment for the young women.

Conclusions
This study adds to the growing body of evidence on the impact cash transfers can have on adolescents and their transitions into adulthood and broadly on the role that economic interventions can play on young women’s risk of HIV. In this study, the cash transfer reduced the risk of physical intimate partner violence. Importantly, this effect was boosted through young women choosing not engage in sexual partnership rather than changing dynamics within existing partnerships. As both HIV/AIDS and IPV are major public health challenges in South Africa, interventions to prevent sexual transmission of HIV should not ignore the influence of partner violence on women’s lives. Our results highlight the potential that CCT interventions may play in addressing these critical intersections by reducing physical IPV among adolescent girls and young women in South Africa. Moreover, along with other recent studies, our results suggest that integrating targeted public health interventions into structural interventions can work synergistically to progress the SDGs related to young women’s health, education, and empowerment.
Competing Interests

The authors have no competing interests to declare.

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Authors’ Contributions

KNK and JKE contributed to data analysis, data interpretation, and writing of this manuscript. AP and AS contributed to study design, development of data collection instruments and the protocol, study oversight and implementation, data interpretation, data analysis, and writing of this manuscript. CM and KK contributed to study design, development of data collection instruments and the protocol, study oversight and implementation, and editing of this manuscript. RT contributed to the protocol development, study implementation and oversight, and editing of the manuscript. JPH contributed to study design, development of the protocol, data interpretation, and editing of this manuscript. JW contributed to data analysis, data interpretation, and editing of the manuscript. RW contributed to study implementation and oversight, and editing of the manuscript.
Additional Files
Additional file 1: Online Appendix

List of Abbreviations
CCT: Conditional Cash Transfer
IPV: Intimate Partner Violence
SRPS: Sexual Relationship Power Scale
CDE: Controlled Direct Effect
HPTN: HIV Prevention Trial Network

References


Online Appendix

Models used to Estimate Controlled Direct Effects

We first estimate model (1) and (2) (below) for each mediator where \(A\) represents the treatment, \(Y\) the outcome, \(M\) the mediator, and \(C\) additional covariates. Model (2) is the same as model (1) but also includes treatment-mediator interactions (AM). These models were proposed by Valeri and Vanderweele [2013] and are defined for binary outcomes and mediators. Since outcomes are relatively common we use log-linear models to estimate risk ratios [Valeri & Vanderweele, 2013]. Using the counterfactual framework, we then estimate controlled direct effects (CDE) from the regression parameters in either Models (1) or (2) depending upon whether there is an interaction effect (AM).

\[
\begin{align*}
(1) \quad \log\{E(Y|A,M,C)\} &= \theta_0 + \theta_1 A + \theta_2 M + \theta_3 C \\
(2) \quad \log\{E(Y|A,M,C)\} &= \theta_0 + \theta_1 A + \theta_2 M + \theta_3 AM + \theta_4 C
\end{align*}
\]

Table A1. Causal Mediation Models with and without Interaction Effects

<table>
<thead>
<tr>
<th></th>
<th>Sexual debut</th>
<th>Any sexual partner in past 12 months</th>
<th>Number of Sexual Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Treatment</td>
<td>0.68***</td>
<td>0.56***</td>
<td>0.68***</td>
</tr>
<tr>
<td></td>
<td>(0.61 - 0.76)</td>
<td>(0.47 - 0.66)</td>
<td>(0.61 - 0.76)</td>
</tr>
<tr>
<td>Mediator</td>
<td>1.46***</td>
<td>1.27**</td>
<td>1.36***</td>
</tr>
<tr>
<td></td>
<td>(1.30 - 1.64)</td>
<td>(1.10 - 1.47)</td>
<td>(1.20 - 1.53)</td>
</tr>
<tr>
<td>Interaction</td>
<td>1.41**</td>
<td>1.58***</td>
<td>1.236***</td>
</tr>
<tr>
<td></td>
<td>(1.13 - 1.76)</td>
<td>(1.27 - 1.96)</td>
<td>(1.11 - 1.37)</td>
</tr>
<tr>
<td>Observations</td>
<td>4,848</td>
<td>4,806</td>
<td>4,806</td>
</tr>
</tbody>
</table>

Notes: Adjusted for age and baseline mediator value; coefficients are RR (95%CI) estimated using GEE models with log-linear specification and robust SEs. Mediators labeled at the top are included into the regressions in columns (1), (3), and (5) while mediator and mediator-treatment interactions are also included in columns (2), (4), and (6)

\* pvalue<0.10, *pvalue<0.05, **pvalue<0.01, ***pvalue<0.001

Results in Table A1 show that using model (1) in columns 1, 3, and 5, treatment effects in the first row remain similar in size and significance to the total treatment effect of RR 0.66 (CI: 0.59 - 0.74). Additionally, all mediator coefficients are significant and show that any engagement in a sexual partnership increases the risk of physical IPV. Using model (2) in columns 2, 4, and 6, we
also see significant effects on each mediator-treatment interaction terms. Therefore, we used model (2) to estimate CDEs in the paper.

**Identifiability of Casual Mediation Effects**

In order to interpret causal mediation effects under the counterfactual approach, certain identifiability assumptions are required: no unmeasured confounding between 1) treatment and the outcome, 2) treatment and the mediator, 3) mediator and the outcome (including no confounder affected by treatment) [Valeri and Vanderweele, 2013]. Randomization to treatment arms in this study assures assumptions (1) and (2) are met, but it does not guarantee that no confounding holds for the mediator-outcome relationship in assumption (3) because the mediator was not randomized. Therefore, to account for potential confounding issues between the mediator-outcome relationship, we control for observed pretreatment covariates including baseline mediator levels and participant age in all models [Imai et al., 2010].