Social Stigma as a Barrier to HIV Testing: Evidence from a Randomized Experiment in Mozambique

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Abstract

Public health experts have seen the stigma as a leading barrier affecting the delivery of HIV-related health care. By using a field experiment in Mozambique, this study identifies the role of stigma concerns in hindering HIV testing and quantifies the stigma barrier. To obtain local measures of the HIV stigma environment in the study sites, we conducted a baseline survey one year before the experiment. Experiment participants with excessive concerns, defined as overestimating the stigma in their communities, were randomly assigned an intervention to relieve stigma concerns. The intervention, which drew upon findings from the baseline survey, was designed to reveal the correct degree of stigma that a participant had overestimated. Analyses show that this intervention raised the HIV test uptake rate by 7.7 percentage points (or by 37 percent) from 20.7 percent under the control condition. To quantify the intervention effect, I introduced testing coupons of different values to estimate the demand curve for an HIV test. The concern-relieving intervention raised an individual's willingness-to-pay for an HIV test by $1.30, or more than half of the daily cost-of-living in the study population.

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1 Introduction

In 2013, the United Nations called for ninety percent of all people living with HIV to know their status by 2020 in its 90-90-90 goal.[1] A month shy of 2020, however, this goal will not be met. In 2018, the last year for which data was collected, only 79 percent of the global infected population knew their status. Insufficient status-awareness matters because it imposes extraordinary challenges on public health authorities to prevent transmission and expand medical treatment.

Crucial to overcoming this challenge is to raise the HIV testing rate, and especially in Sub-Sahara Africa, which remains the world's most HIV-affected region. Of the 37.9 million people living with HIV, 25.6 million are from Sub-Sahara Africa. While global donors, through a decade-plus of collaboration with local partners, have made HIV testing freely accessible in almost all of Sub-Sahara Africa, a low test-uptake rate has substantially undermined this supply-side effort.[2]

Medical practitioners and community leaders often blame the stigma attached to HIV for the low testing rate. Anecdotal evidence suggests that people have avoided HIV testing for fear of being seen and stigmatized by their neighbors. Although public health scholars have documented correlations between high degrees of stigma and low testing rates under various circumstances (Sambisa, Curtis and Mishra, 2010; Berendes and Rimal, 2011; Maughan-Brown and Nyblade, 2014; Kelly, Weiser and Tsai, 2016) , there is a dearth of well-identified evidence on the causal effect of stigma on HIV testing. Nor do we know how large an impact the stigma imposes on an individual's testing behavior. The main challenge to causal identification is that stigma, as a parameter of society, is difficult to experimentally alter without altering confounding factors at the same time.

My paper overcomes this challenge by employing an intervention that tackles concerns for stigma at the individual level.[3] I use a randomized control trial (RCT) in Mozambique for two purposes: to identify the role stigma concerns play in hindering HIV testing and to quantify the stigma barrier. To obtain local measures of the social stigma attached to HIV, we conducted a baseline survey in the study communities one year before the RCT. Participants of the

[1] The three specific goals are: "By 2020, 90% of all people living with HIV will know their HIV status; 90% of all people with diagnosed HIV infection will receive sustained antiretroviral therapy; 90% of all people receiving antiretroviral therapy will have viral suppression."

[2] Data source: UNAIDS AIDS information program: http://aidsinfo.unaids.org

[3] I follow the conceptual work of Goffman (1963) and define the stigma attached to HIV as the phenomenon that people living with HIV are socially avoided. Accordingly, the concerns for the stigma are individuals' concerns for being avoided in social life because of their association with HIV. The stigma measures and interventions used in this study strictly followed this definition.

Public health scholars have discussed the concept of the stigma attached to HIV more broadly (Parker and Aggleton, 2003; Stangl, Brady and Fritz, 2012; Stangl et al., 2013). According to previous conceptual work, the broad concept of stigma has manifestations beyond social avoidance, such as internal stigma (feel ashamed of oneself) and enacted discrimination (be assaulted or treated unfairly by others). My study adopted a narrower working definition of stigma to allow for rigorous quantitative analyses. Social avoidance is the core manifestation of all stigmas and can be measured in my study setting. The rise of social avoidance is not the focus of this study; it could stem from the moral judgment on the infected person or people's excessive concerns for infection. See Stangl, Brady and Fritz (2012) and Stangl et al. (2013) for reviews.

RCT estimated the degree of stigma in their community before entering a randomization process. Those with excessive stigma concerns, i.e., overestimated stigma in their community, were randomly assigned to receive an intervention to alleviate concerns. The concern-relieving intervention, which was individually tailored, revealed the true degree of stigma that a participant had overestimated. We then tracked test-seeking behavior.

I find that the concern-relieving intervention raised the participants' test uptake rate by 7.7 percentage points, or by 37%, from 20.7 percent under the control condition. This experiment provides clear evidence that the stigma concerns for stigma are a barrier that has caused people to avoid taking HIV tests.

To quantify the stigma barrier, I introduce different levels of monetary incentives for HIV testing. The testing service in Mozambique is free and anonymous. To track individuals' test-seeking behavior, I offered all study participants coupons (a conditional cash transfer) to take tests. The Control Group and the Concern-Relieving Intervention Group received coupons of 50 Meticais (2.25 dollars by PPP), which was equivalent to the daily cost-of-living. An additional study group, the High-Incentive Group, was introduced in parallel, where participants received no intervention but coupons of 100 Meticais. The Control Group and the High-Incentive Group locally pin down the demand curve for an HIV test. On the demand diagram, relieving stigma concerns raised individuals' willingness to pay (WTP) for an HIV test by 29 Meticais (1.30 dollars by PPP).

My paper contributes to the literature on understanding HIV testing behavior in developing countries. While many studies in this literature have focused on exploring practical interventions to promote HIV testing, they have often paid less attention to investigating the mechanisms or identifying a specific barrier inhibiting HIV testing. For example, researchers have found that financial incentives and home-base testing delivery could raise the testing rate (Swann, 2018; Moshoeu et al., 2019), and have argued that alleviating stigma was a working channel. Nevertheless, as both interventions addressed multiple potential barriers at the same time,[4] we still do not know which barriers prevent individuals from seeking a test or the best ways to overcome these barriers. A recent effort to identify the barrier of stigma concerns is Derksen and van Oosterhout (2019). They found that disseminating educational messages in a community raised the HIV testing rate and argued that reducing the residents' stigma concerns was the mechanism. The stigma's role in their study, however, was not directly supported by experimental evidence.[5] Confounding mechanisms could still drive the effect, such as people inferring higher

[4]Providing financial incentives and delivering home-based testing services may both address several barriers at the same time: monetary cost, by compensating or avoiding transportation fees and loss of time; procrastination, by offering instant incentives for testing or reducing cost; stigma concerns, by concealing the intrinsic motivation to learn one's status or avoid being seen by others (Thornton, 2008; Feyissa, Lockwood and Munn, 2015; Swann, 2018; Moshoeu et al., 2019).

[5]Derksen and van Oosterhout (2019) argued with suggestive evidence that their informational intervention—health education meetings disseminating the effectiveness of the HIV treatment in preventing transmission—made people think that their community became more aware that HIV positive persons on medication have a low chance of transmitting HIV. Hence, people in their intervention group had fewer concerns for "statistical discrimination" by potential sex partners, and, as a result, sought more tests.

medication effectiveness or acting altruistically. The lack of knowledge on specific barriers obstructs us from learning the underlining motivations behind human behavior and prevents us from designing cost-effective interventions to fight HIV.

In contrast to the existing studies, my experimental intervention directly and solely manipulates an individual's stigma concerns. Any observed effect on the testing rate can be traced back to relieved stigma concerns. The clear-cut design allows me to establish the causal effect of the stigma concerns on testing and to quantify its impact.

My study also contributes to the literature on the role of stigma in socio-economic life. Stigmas widely exist in human society and increasingly attract economists' attention. Some earlier work theoretically analyzed the rise and implications of stigma related to social welfare receipt and divorce (Moffitt, 1983; Besley and Coate, 1992; Ishida, 2003). A strand of empirical literature studied how stigma concerns affect individuals' decisions to claim welfare and reached mixed conclusions (Bhargava and Manoli, 2015; Friedrichsen, König and Schmacker, 2018).

The stigma is especially widespread in the realm of public health. Many health conditions are stigmatized (Puhl and Heuer, 2009; Bharadwaj, Pai and Suziedelyte, 2017), HIV infection being a common and policy-relevant example. Hoffmann, Fooks and Messer (2014) documented evidence of the stigma attached to HIV: The general population tended to avoid objects touched by people living with HIV. In my study, I take a step further to show that stigma concerns can cause behavioral changes in the vulnerable population and lead to real health and economic consequences.

In addition, my work relates to the literature on how misperceived social parameters affect human behavior (Jensen, 2010; Cruces, Perez-Truglia and Tetaz, 2013; Armona, Fuster and Zafar, 2018). The intervention tool I use is built on a type of "norm-based interventions," which alter people's perceptions of certain social norms by revealing summary statistics of behavior in a reference group (Benabou and Tirole, 2011). Researchers have used "norm-based interventions" to study individuals' reactions to learning social norms in energy consumption (Schultz et al., 2007), female labor force participation (Bursztyn, González and Yanagizawa-Drott, 2018), and attitudes toward healthy sexual relationships (Banerjee, Ferrara and Orozco-Olvera, 2019). The study setting of Banerjee, Ferrara and Orozco-Olvera (2019) was the closest to mine. In their experiment, young participants in Nigeria first viewed an entertainment-education TV series promoting healthy sexual relationships and then reported their attitudes towards the TV contents. The treatment group was informed of their peer's average post-view attitudes before they reported their own. The authors did not find that the intervention of revealing peer's attitudes affected participants' attitudes.

Unlike previous studies, my intervention identifies new parameters beyond the effect of social norms. I use social opinion statistics as a tool to mitigate a psychological barrier, i.e., the stigma concerns. The outcome of interest, taking up an HIV test, is a behavior differing from the one in which I reveal summary statistics. My paper shows how social opinions collected from

hypothetical questions can affect the decision on behavior of high stakes. Moreover, I combine the norm-based intervention with varying financial incentives to quantify the intervention effect.

2 Background

2.1 The HIV Epidemic and Testing Services in Mozambique

HIV prevalence in Mozambique reached 12.6% among adults in 2018, making it one of the countries most affected by the epidemic. Mozambique has fallen behind the United Nations' 90-90-90 goal in each step of the HIV treatment cascade. Only 72% of all people living with HIV in Mozambique know their status. This low awareness has become a major obstacle for HIV treatment and prevention. In 2018, there were 150,000 new HIV infections and 54,000 AIDS-related death in Mozambique, accounting for one-twelfth and one-fourteenth, respectively, of the global totals.[6]

Mozambique built up its nationwide standardized HIV-testing (formally known as Health Counseling and Testing) service system following WHO guidelines. Beginning in 2008, the Mozambican government integrated HIV-related services into other clinical services in sanitary units (US) in communities. HIV-related services and materials are free of charge in all US's.

In 2017, Mozambique conducted 7,866,465 HIV tests. (The ratio of the number of tests to population is 0.273.) The majority, or 80.2%, of the tests were conducted through the provider-initiated counseling and testing (Portuguese abbreviation ATIP) approach, where doctors referred patients with symptoms of infections to take tests for HIV. The ATIP approach is typically only able to catch HIV infections late in the progress when the virus may already have transmitted to others, and the patient has missed the best window to initiate medical treatment. Only 12.7% of HIV tests were initiated by general residents who voluntarily sought to learn their status in a sanitary unit (formally known as the user-initiated counseling and testing approach, Portuguese abbreviation ATIU).[7] In a high HIV-prevalence region like Mozambique, encouraging the general population to learn its status before any sign is shown is essential for preventing transmission and improving treatment efficacy. In this study, we collaborated with the local sanitary units, where we refer eligible participants to take HIV tests through the ATIU approach and track their testing behavior.

2.2 Study Population

My research experiment is embedded in a broader evaluation study of the anti-poverty program *Força à Comunidade e Crianças* (FCC, "Strengthening Communities and Children") in Mozambique.[8] Our research team conducted a household survey, hereafter the baseline survey, between

[6]Data source: UNAIDS (2019).

[7]Data source: "Annual report on activities related to HIV/AIDS 2017" National Healthcare Service, Mozambican Ministry of Health (Portuguese: *Relatório Anual 2017 Relatório Anual das Actividades Relacionadas ao HIV/SIDA*).

[8]See Yang et al. (2019) for an extensive discussion of the FCC program.

May 2017 and March 2018 in 76 communities across three provinces in central Mozambique. The baseline survey covered a population-representative sample in each study community and collected rich information about household members' health, education, knowledge about HIV, and social opinions. The experiment analyzed in this paper was conducted on an economically disadvantaged subset of the baseline survey sample. 71.6% of the baseline households are categorized as "vulnerable" according to a list of pre-specified criteria, and they constituted the pool of potential participants for this experiment.[9]

2.3 Measures of the Stigma Environment

We constructed three measures of stigma environment within each community by summarizing the baseline survey responses to each of the following questions.

Q1. Would you buy fresh vegetables from a shopkeeper if you knew that this person had HIV? (Yes/No)

Q2. If a member of your family became sick with AIDS, would you be willing to care for them in your own household? (Yes/No)

Q3. In your opinion, if a teacher has HIV but is not sick, should they be allowed to continue teaching at school? (Yes/No)

The questions assess an individuals' tendency to avoid people living with HIV (stigmatize HIV); an affirmative answer indicates a supportive attitude, while a negative answer indicates stigmatization. A higher fraction of affirmative responses from a community indicates a local environment with less stigma.

The major takeaway from the baseline environment assessment is that the fraction of respondents giving affirmative answers was high across all communities, indicating low social stigma attached to HIV. In an average community, the fractions of respondents giving an affirmative answer to the three questions were 80.1%, 93.2%, and 89.2%, respectively. The variation across communities is moderate, and except for Q1 in three communities, the supportive fractions are always higher than 60%.[10] The three community-level stigma measures are used in the experimental intervention discussed later to mitigate participants' concerns for stigma.

The worldwide panel AIDS Indicator Survey (AIS) has used the same three questions to monitor HIV-related stigmas. The low stigma finding from the baselines survey is consistent with the findings from the AIS panel in Mozambique. The four rounds of AIS between 2003 and 2015 show a trend of rapidly lowing stigma associated with HIV in Mozambique. Figure 1 presents the four rounds of AIS and our baseline sample together.

[9] We assessed a household's vulnerability in 11 dimensions that covered income, food security, adult-to-child ratio, and health conditions. Please see Appendix A3 for details. Since the baseline survey sample is population-representative, the participant pool can be considered the bottom 71.6% of Mozambique's population in the economic well-being distribution. As a comparison, the poverty headcount ratios at $1.90 (2011 dollar) a day and $3.20 (2011 dollar) a day are 62.4% and 81.5% of the country's population, respectively. Hence, people in my participant pool roughly lived on $1.90 to $3.20 a day. Data source: World Bank Data.

[10] See Appendix A4 for the three measures in each study community.

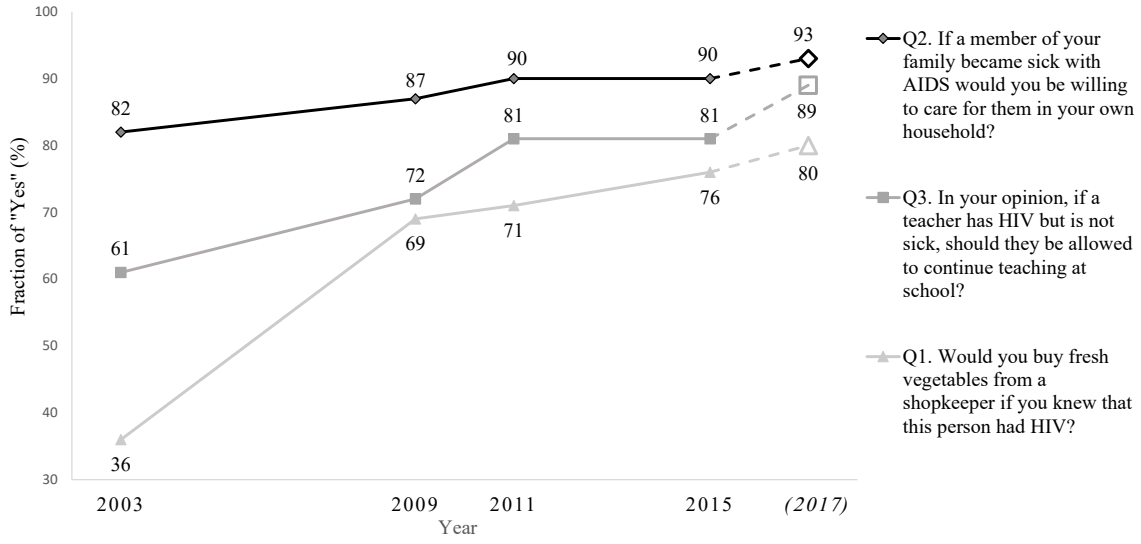

Figure 1: Stigma Environment Measures in Mozambique over Time

Notes: Data points for 2003, 2009, 2011, and 2015 are calculated from the nationally representative sample of Mozambique AIDS Indicator Survey by USAID. Data points for 2017 are calculated by taking a simple average from the baseline survey in this study.

3 Experimental Design

3.1 Recruitment Survey and Stigma Concern Assessment

The experiment was rolled out between May and October in 2019. To recruit participants, enumerators visited a list of prespecified "vulnerable" households from the baseline sample. Adults available at the time of home visits first answered a survey and then, depending on their survey responses, were assigned to a study group at random.

The purpose of the survey upon recruitment is threefold. First, it collected testing histories and screened eligible individuals to receive HIV test coupons. Survey respondents who were already known to be HIV positive or had been tested within the last three months were not offered coupons, and, thus, excluded from the RCT.[11] 62% of the surveyed people were eligible for our testing coupons; 14% were not eligible because they self-reported to be HIV positive; 24% were not eligible because they had been tested negative within 3 months before the survey. Second, in the survey, we assessed participants' concerns for stigma. Participants who overestimated social stigma in their community were subsequently randomized to the Concern-Relieving

[11]The government-recommended frequency of testing for the general population is once per six months. See "National Guideline for the Implementation of the Counseling and Testing in Health" issued by the Mozambican Ministry of Health in 2017. (Portuguese: *Directriz Nacional Para a Implementação do Aconselhamento e Testagem em Saúde.*)

Intervention Group or the Control Group. Lastly, the recruitment survey collected a rich set of pre-intervention characteristics of the participants.

During the recruitment survey, we assessed each respondent's concerns for the stigma attached to HIV before randomly assigning them to different experiment conditions. The baseline survey delivered the encouraging news of a low stigma environment; however, people may lack accurate knowledge about the environment in which they live. In fact, it is not the true stigma environment, but people's *beliefs* about the stigma environment that concerns them and may affect their test-seeking decision.

In the recruitment survey, we ask participants to report their beliefs about the three stigma measures of their community:

EQ1. If I ask the question, "Would you buy fresh vegetables from a shopkeeper if you knew that this person had HIV?" to 10 people in your neighborhood, how many of them would you expect, to say "Yes"?

EQ2. If I ask the question, "If a member of your family became sick with AIDS, would you be willing to care for them in your own household?" to 10 people in your neighborhood, how many of them would you expect, to say "Yes"?

EQ3. If I ask the question, "In your opinion, if a teacher has HIV but is not sick, should they be allowed to continue teaching at school?" to 10 people in your neighborhood, how many of them would you expect, to say "Yes"?

If a *belief* is lower than the corresponding *truth* in her community, then this participant has overestimated stigma in this measure. For example, if in the baseline survey, 90% of the respondents in a community said "yes" when asked if they would buy fresh vegetables from a shopkeeper whom they knew to have HIV, but a participant believed that only 70% of people in her community would have said "yes" to the question, then this participant had *overestimated* stigma in her community.

Table 1 summarizes participants' beliefs in the recruitment survey and compares them with statistics from the baseline. The coupon-eligible sample, on average, believed that 70.2%, 77.5%, and 81.4% of their neighbors would give affirmative answers to the three stigma-measuring questions. These numbers are significantly lower than the fractions collected from the baseline. Figure 2 depicts the distribution of bias of participants' beliefs about the stigma measures. The bias is defined as a participant's belief minus the true fraction of people in her community giving affirmative answers in the baseline survey. A negative bias indicates overestimating stigma.

A participant is defined as "concerned" for social stigma if she overestimated at least one of the stigma measures in her community. 62.7% of the coupon-eligible sample fell into this category. Individuals in this category constituted the primary analysis sample and were randomly selected to receive the concern-relieving intervention.

At this point, we can glance at the correlation between the stigma concerns and past test uptake behavior in our study population. For everyone in the survey sample, we take an average of her guesses of the three stigma measures to obtain an individual "stigma perception" measure.

Table 1: Beliefs and Truths of the Stigma Environment

Stigma Measure Question	Obs.	Mean belief	Truth from the baseline survey	p-value of ttest: belief = truth	Share overestimated stigma in this question
Q1	1,392	70.2%	79.4%	<0.001	46.0%
Q2	1,397	77.5%	92.8%	<0.001	51.3%
Q3	1,402	81.4%	88.8%	<0.001	40.8%
Overestimated stigma measured in at least one of the three questions					62.7%

Notes: This table reports the beliefs of the coupon-eligible sample (sample size = 1,588). The fraction of respondents answered "yes", Column (3), is calculated by reweighing the baseline sample to match the geographic distribution of the experiment participants, Column (2). When calculating the fraction of coupon-eligible participants that overestimated stigma measured in at least one of the three questions, missing beliefs are treated as "not overestimate". If we drop the missing beliefs, the fraction is 70.2%.

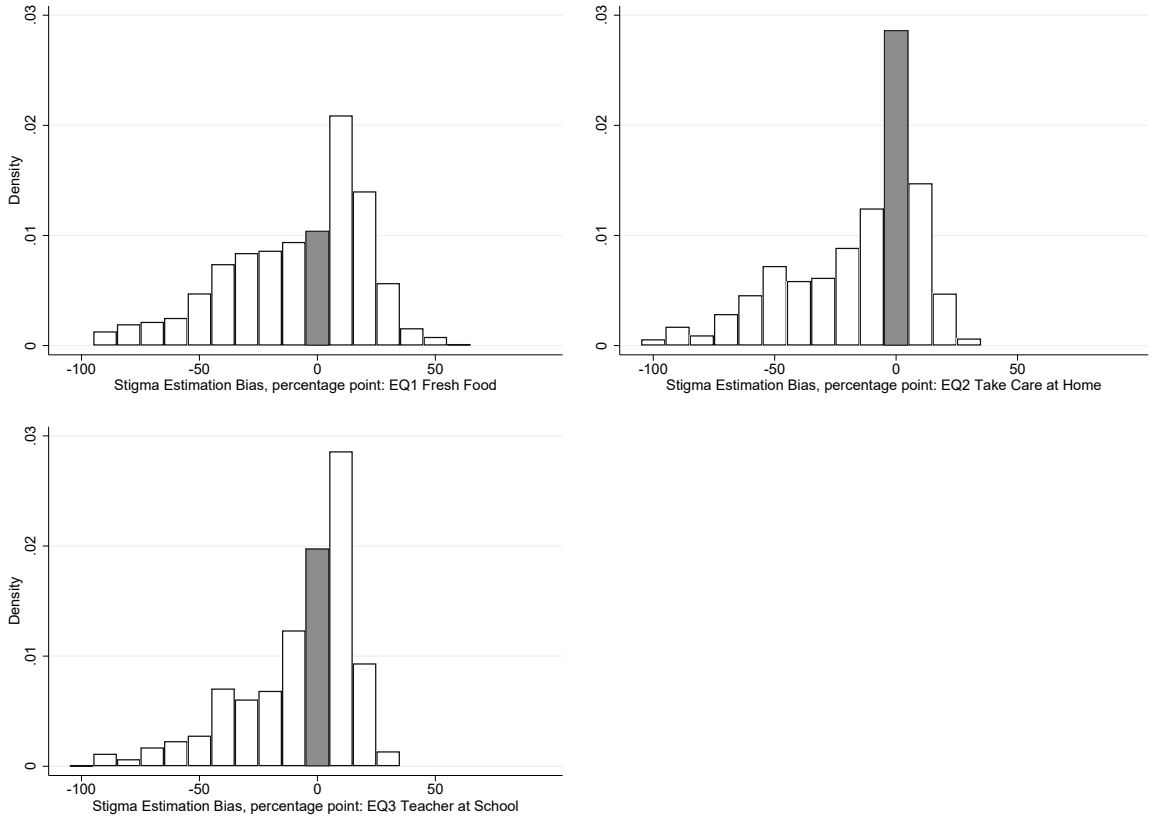

Figure 2: Distribution of Participants' Bias in the Belief about Stigma

Notes: A bias is defined as an individual's belief about a stigma environment measure (an individual's answer to question EQ1, EQ2, or EQ3, transformed to percent, i.e. 6 out of 10 is transformed to 60 percent) minus the true stigma measure obtained from the baseline survey in her communities (summary of question Q1, Q2, or Q3). A negative bias indicates overestimating stigma. The histograms are based on all participants that are eligible for coupons.

Figure 3 divides survey respondents to quintiles by their beliefs about stigma measure and depicts the self-reported testing rate (the fraction of people ever tested for HIV) of each quintile. Those with fewer stigma concerns (i.e., those who guessed a high fraction of people giving affirmative answers to Q1 to Q3) are in quintile 1 while the most concerned people are in quintile 5. Quintile 1 has a significantly higher testing rate compared to other quintiles. The pattern in Figure 3 echoes previous findings that greater concerns for stigma are associated with a lower HIV testing rate, but causality remains unknown. This association could come from a hidden third factor that caused high stigma concerns and fewer test uptakes at the same time or derive from the inverse causal channel that learning one's HIV status leads to lower stigma concerns. To rule out these hypotheses, we introduced the concern-relieving intervention to experimentally mitigate the stigma concerns of a random subset of participants.

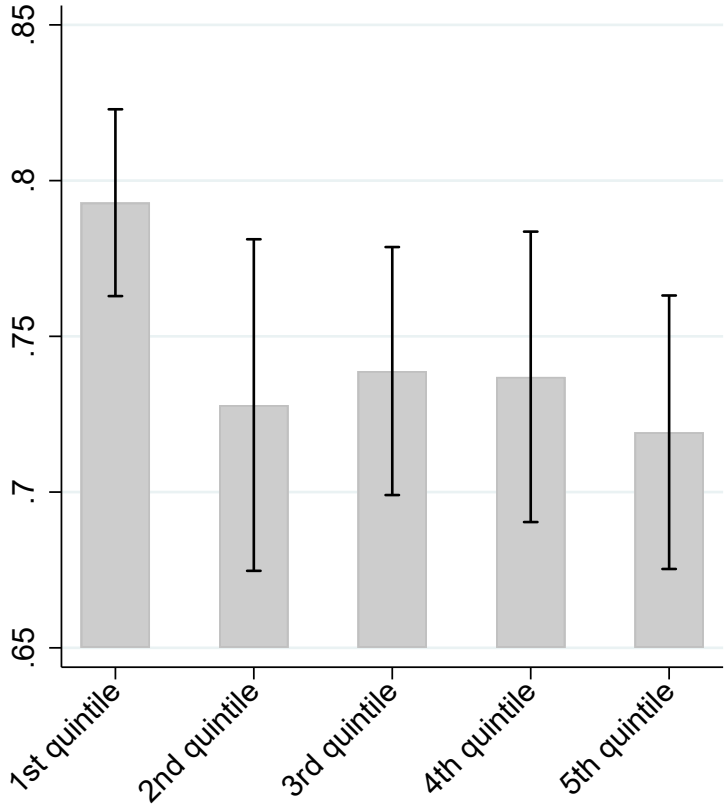

Figure 3: HIV Testing Rate by Belief about Stigma

Notes: The *y-axis* is the fraction of recruitment survey respondents self-reported to had ever tested for HIV. The *x-axis* is the quintile groups of the belief about local stigma measures. An individual's belief is the average of her answers to question EQ1, EQ2, and EQ3, a higher average indicates that this person perceived less stigma. Individuals are ordered by their beliefs, with those who perceived the least stigma on the left and those perceived the most stigma on the right. The first quintile group includes the left-most 20 percent, and so on.

3.2 The Concern-Relieving Intervention

This intervention shares the measures of stigma environment from the baseline survey with the participants. To protect human subjects, the information sharing is asymmetric – a true measure was revealed to a participant only when she "overestimated" stigma in that measure, but not when she correctly estimated or underestimated it.

One-third of the "concerned" participants received the concern-relieving intervention by random selection. The intervention was administered after the recruitment survey. The enumerator revealed measure(s) of the stigma environment that the participant had overestimated and explained the implications. As an example, a piece of the enumerator's scripts for the interventions goes as follows:

> *I'd like to share with you some information we collected from your neighborhood. Recall that a few minutes ago, I asked you to guess, out of 10 people, how many of them would have answered "yes" to the following question:*
>
> *"Would you buy fresh vegetables from a shopkeeper if you knew that this person had HIV?".*
>
> *Your guess was [6 out of 10] people would answer "yes."*
>
> *In fact, we did ask a large number of people this question last year in your neighborhood. The fact is [more than 9 out of 10 people (or 91.5%)] answered "yes." People in your community are more acceptive of people infected with HIV than you thought they would be.*

The intervention shared one to three pieces of such information depending on the number of overestimates a participant made in the concern-assessing process.

3.3 Coupon Distribution

The primary outcome of interest is the HIV test uptake. In Mozambique, HIV tests are voluntary and anonymous. We adopted coupons to track participants' test-seeking behavior. HIV testing is free of charge at the local clinics. Hence, a coupon should be considered a conditional cash transfer. After a participant completed the survey and the concern-relieving intervention (when applicable), the enumerator distributed a testing coupon to each participant who was not already known to be HIV positive and had not been tested within the last three months.

We varied the value of the coupons to pin down the effect of monetary incentives on testing. A regular-value coupon was worth 50 Meticais (2.25 dollars by PPP), and a high-value coupon was worth 100 Meticais. As discussed in the previous section, the study population roughly matches the population in absolute poverty in Mozambique who lived on \$1.90 to \$3.20 (2011 dollars) a day. A low-value coupon had the value of an average participant's daily cost-of-living.

In addition to one coupon for each adult participant, we also distributed coupons of the same value for each of the participant's eligible children. A child followed the same eligibility criteria for a coupon as an adult. The enumerator informed the participant that a coupon should only

be used by the designated person (the adult coupon for the participant himself or herself and the child coupons for any eligible children). For the participant's convenience, coupons for an adult male, adult female, and a child were of different designs.

At the time of distributing coupons, we also informed the participants of the typical time costs of testing in the local sanitary units, and the method of payment for coupon redemption. To avoid any pressure or concerns for confidentiality loss, we confirmed that at the time of coupon redemption, the study team would not collect any individually identifiable information or ask for their test results.

3.4 Randomization Structure and Balance Test

We jointly randomized the concern-relieving intervention and the value of coupons. Figure 4 summarized the group structure. Participants of the Concern-Relieving Intervention Group received regular-value coupons. The rest of the "concerned" participants were randomized to two groups: the Control Group, who received regular-value coupons, and the High-Incentive Group, where high-value coupons were offered. The non-concerned participants were also randomized to receive regular-value or high-value coupons, but none received any information about stigma. The randomization was conducted at the household level. If more than one adult from a household were "concerned," they received (or did not receive) the concern-relieving intervention at the same time. (When multiple adults in the same household were to receive the concern-relieving information, the information each person received was still individually tailored and delivered in private.) All members from the same household, including children, received coupons of the same value. Table 2 reports summary statistics of the coupon-eligible sample and conducts balance checks.[12]

3.5 HIV Test and Coupon Redemption

All coupons were valid for 14 days. A coupon was redeemable at the designated sanitary units when someone presented proof of HIV-testing with the coupon to the research staff on site. The payment was made in digital cash through MPesa. There was a unique barcode on each coupon that allowed us to link the use of the coupon to one's survey responses.

To redeem a coupon, a participant should take an HIV test at a local sanitary unit. To ensure the convenience of testing, we involved all the commonly used sanitary units of the participating communities. They included but were not limited to all the geographically closest ones. When distributing the coupons, we encouraged participants to get tested in the closest sanitary units and promised staff presence in those units within the 14-day window. Participants, however, were able to redeem coupons at any sanitary units when our research staff was on site.

The HIV test in a sanitary unit is based on a 3-stage process.

[12]Please see Appendix A1 for summary statistics of other samples.

Table 2: Balance Table

Variables	Obs.	Control Group Mean (s.d.)	Diff: Concern-Relieving Intervention minus Control (p-value)	Diff: High-Incentive minus Control (p-value)
Indicator: female	996	0.685	0.002	0.007
		(0.465)	(0.947)	(0.878)
Age	990	36.458	0.584	-2.878
		(16.088)	(0.622)	(0.061)
Education in years	991	6.356	-0.418	-0.017
		(4.005)	(0.153)	(0.964)
Indicator: is the primary guard of some child(ren)	996	0.696	0.027	0.032
		(0.461)	(0.437)	(0.485)
Indicator: respondent provided a private phone number	996	0.541	-0.028	0.075
		(0.499)	(0.457)	(0.108)
# of sex partners in the last 12 months: none	943	0.199	0.002	0.012
		(0.400)	(0.954)	(0.748)
# of sex partners in the last 12 months: only one	943	0.667	0.017	0.008
		(0.472)	(0.659)	(0.853)
# of sex partners in the last 12 months: more than one	943	0.134	-0.018	-0.020
		(0.341)	(0.488)	(0.527)
HIV-test history: never tested	985	0.388	0.047	0.017
		(0.488)	(0.220)	(0.707)
HIV-test history: tested more than one year ago	985	0.264	-0.011	0.006
		(0.441)	(0.741)	(0.897)
HIV-test history: tested within one year	985	0.348	-0.036	-0.023
		(0.477)	(0.335)	(0.615)
# of correct answers out of 15 HIV questions	996	11.919	-0.131	-0.449*
		(2.998)	(0.581)	(0.094)
Subject risk of HIV+: the higher the riskier	965	1.761	0.056	-0.034
		(0.920)	(0.389)	(0.652)
Distance in km between the household and a clinic	973	2.128	-0.010	0.086*
		(2.941)	(0.791)	(0.054)
Indicator: household go without food in the past 12 months	996	0.564	-0.018	0.047
		(0.496)	(0.629)	(0.266)
Indicator: household has HIV+ member	920	0.072	0.016	0.056**
		(0.258)	(0.484)	(0.038)
1st principal component of the ownership of 14 assets†	996	0.884	0.003	0.201
		(2.085)	(0.986)	(0.262)

Notes: The p-values are from t-tests of equality. The t-tests are controlled for community fixed-effects and enumerator fixed-effects.

† The 14 assets are car, motorbike, bike, radio, TV, sewing machine, refrigerator, freezer, iron, bed, table, mobile phone, clock, and solar panel. I use the mean and standard deviation of each ownership indicator in the baseline sample to standardized the indicators. Loadings of each indicator to construct the first principal component are also obtained from the baseline sample.

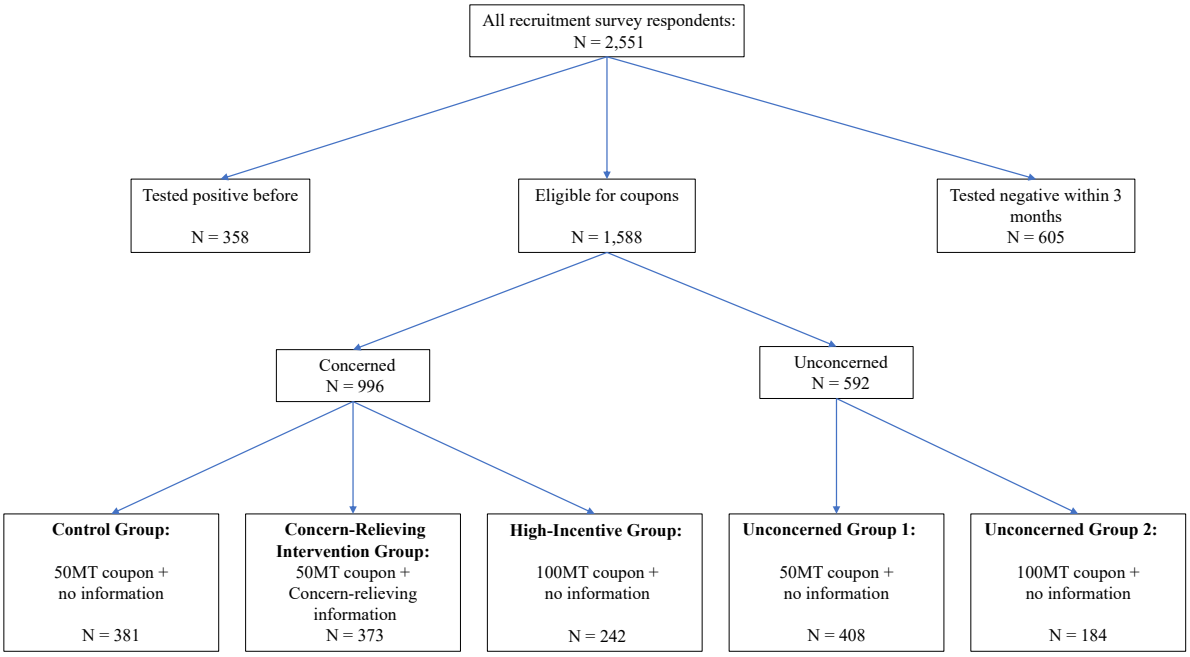

Figure 4: Experimental Design and Sample Structure

1. *Pre-test counseling*
   The health care provider will address HIV prevention strategies, assess the test taker's risk behavior, and introduce possible services available regardless of the test result.

2. *Testing and counseling during testing*
   The health care provider will perform a Rapid Test, explain how to interpret the different potential test results, and provide psychosocial support to face the test result.

3. *Post-test counseling*
   The health care provider will review the test result with the test taker and encourage the testing of partners. Depending on the test results, the test provider will refer the test taker to follow-up health counseling and services.

All three stages were conducted one-on-one in the clinics involved in this study. The standard 3-stage process took around 30 minutes per person. At the end of the process, the doctor would sign a proof-of-testing slip for the test taker. The research staff on-site would pay the coupon value when a coupon was presented with proof of testing.

When redeeming the coupon, the research staff did not try to identify the coupon holder or link the coupon to any information collected from the survey. After the coupon value was paid, the redemption staff would scan the coupon barcode, take notes of the coupon holder's gender and age range (below or above 18 years old), and ask where the coupon was from. The coupon barcode and coupon holder's information were later linked to the recruitment survey responses.

4 Experimental Results

4.1 Main Result - Test Uptake

Comparing the test uptake rate of the Control Group and the Concern-Relieving Intervention Group identifies the intervention effect, which in turn reveals the role of stigma concerns on testing.

Figure 5 compares the raw test uptake rate of the two groups. Test uptake is defined as a coupon distributed to a participant being used within 14 days by an adult of the same gender and self-reported as the original coupon recipient. 20.7 percent of the participants under the control condition take up a test. The test uptake rate increases to 27.1 percent with the concern-relieving intervention. (The p-value of a t-test of equality is 0.0441.)

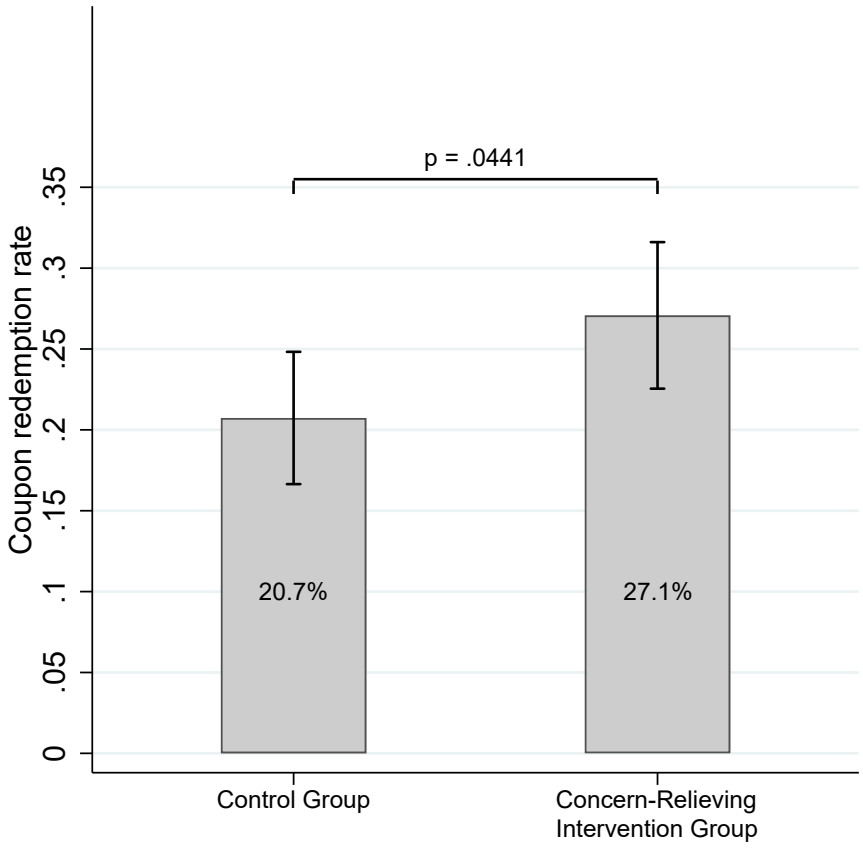

Figure 5: Test Uptake Mean Comparison: Control and Intervention

Notes: The *y-axis* is the HIV test uptake rate measured by the fraction of participants redeemed testing coupons. Both the Concern-Relieving Intervention Group and the Control Group received coupons of the value of 50 Meticais.

Table 3 presents the finding in the regression format. Column (1) replicates Figure 5. Column (2) shows the result from regressing Equation (1) that controls for pre-intervention characteristics.

The estimated intervention effect is stable between the two specifications.

$$Y_i = \alpha + \beta G_i^{relieve} + \mathbb{X}_i + \epsilon_i. \quad (1)$$

Y_i is an indicator for individual i taking up an HIV test.[13] $G_i^{relieve}$ is the indicator of receiving the concern-relieving intervention (as opposed to being assigned to the Control Group). $\mathbb{X}_i$ is the vector of individual characteristics. ϵ_i is the error term clustered at the household level. Equation (1) applies to the union of the Control Group and Concern-Relieving Intervention Group sample.[14] The estimated intervention effect 7.7 percentage points.

Table 3: Main Result: The Effect of the Concern-Relieving Intervention

	(1)	(2)
Group Indicator	Test Uptake	
Concern-Relieving Intervention	0.0634**	0.0771**
	(0.0315)	(0.0326)
Control Group Mean	0.207	0.207
Observations	754	754
R-squared	0.006	0.292
Constant	yes	yes
Controls	no	yes

Notes: Standard errors in parentheses. Standard errors are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1. The control variables are: Indicator: a participant is female (yes, no); Indicator: a participant is the primary guardian of a child (yes, no); Indicator: a participant has his or her own mobile phone; Indicator: number of sex partners in the last 12 months (zero, one, more than one); Indicator: time of the most recent HIV test (never tested, tested more than a year ago, tested less than a year ago); Age: in years; Education: highest grade completed Knowledge about HIV; Number of correct answers to the 15 questions testing HIV-related knowledge; Subjective risk of HIV infection (coded 1 to 5); The straight-line distance between the household and the testing clinic (in km); Square of the straight-line distance between the household and the testing clinic (in km); Indicator: the household ever go without food in the last 12 months (yes, no); Indicator: there is an HIV positive household member (yes, no); Asset ownership index: the first principal component of 14 asset-ownership indicators; Enumerator fixed-effects; Community fixed-effects. If any missing value exists for some variable "X," an indicator variable is created for variable X to flag missing status (1 if missing, 0 otherwise). The missing value of the variable X is replaced with zero. The variable X missing indicator variable is added to the set of control variables.

In conclusion, social stigma concerns attached to HIV is a barrier to the test uptake for those people who overestimate stigma. Learning the evidence of a low-stigma local environment raised the likelihood that the concerned individual would take a test by 7.7 percentage points, or by 37%.

[13] A participant is coded as tested if and only if the assigned coupon was used within 14 days after distribution and was used by an adult of the same gender of the original coupon recipient who self-reported as an original coupon recipient. See Appendix A2 for robustness checks of definition variations.

[14] Equation (1) is equivalent to the primary regression equation specified in the Pre-Analysis Plan in identifying intervention effects. I present the regression analysis of Equation (1) in this paper for a more intuitive interpretation. Definitions of control variables $\mathbb{X}_i$ and sample inclusion criteria used for Equation (1) followed the Pre-Analysis Plan. Conducting the primary regression specified in the Pre-Analysis Plan reaches qualitatively the same and quantitatively very similar conclusions. See Appendix A3 for Details.

4.2 Quantifying the Intervention Effect

To quantify the stigma barrier, I include the High-Incentive Group in the analysis. Figure 6 adds the test uptake rate of the High-Incentive Group in Figure 5. Table 4 Column (1) presents the regression analog. Column (2) presents the regression coefficient for Equation (2):

$$Y_i = \alpha + \beta_1 G_i^{relieve} + \beta_2 G_i^{high-incent} + \mathbb{X}_i + \epsilon_i. \tag{2}$$

$G_i^{high-incent}$ is the indicator of receiving 100-Metical coupons as opposed to 50-Metical ones. Doubling the monetary incentive raises the test uptake by 12.0 percentage points.

Participants from the Control Group and the High-Incentive Group are under the same experimental condition (not exposed to concern-relieving intervention) but have received different monetary incentives to take an HIV test. The varying incentive value for the HIV test allows us to locally pin down the demand curve for an HIV test. I derived the demand curve in Figure 7 with point estimates from Table 4, Column (2). Consider the monetary incentives for taking a test as negative prices. At the price of -50 Meticais, the test uptake rate is 20.7 percent. Lowering the price to -100 Meticais increases the test rate by 12.0 percentage points and reaches 32.7 percent. Keeping the price at -50 Meticais but having the excessive stigma concern corrected increases the test rate by 6.9 percentage points, reaching 27.6%. Assuming local linearity, the concern-relieving intervention leads to a 29-Metical (1.30 dollars by PPP) increase in willingness to pay (WTP) for an HIV test. The size of the increase is over half of the daily cost-of-living.

Table 4: Quantifying the Intervention Effect

	(1)	(2)
Group Indicators	Test Uptake	
Concern-Relieving Intervention	0.0634**	0.0686**
	(0.0315)	(0.0323)
High-Incentive	0.119***	0.120***
	(0.0377)	(0.0389)
Control Group Mean	0.207	0.207
Observations	996	996
R-squared	0.011	0.247
Constant	yes	yes
Controls	no	yes

Notes: Standard errors in parentheses. Standard errors are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1. The control variables are the same as in Table 3.

One caveat when interpreting the change of WTP induced by the concern-relieving intervention is that it is only valid around the price levels on which we conducted experiments (between negative 50 to negative 100 Meticais). We remain agnostic about the demand curve's shape beyond this price range. Researchers have pointed out that a financial incentive itself may relieve

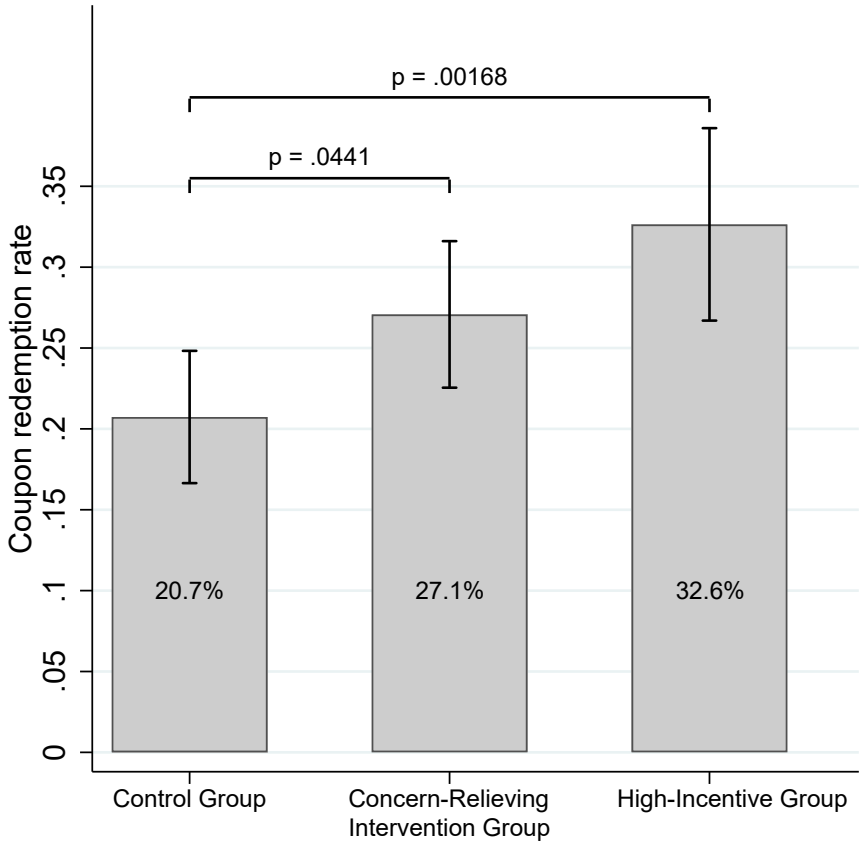

Figure 6: Test Uptake Mean Comparison: Three Study Groups

Notes: The *y-axis* is the HIV test uptake rate measured by the fraction of participants redeemed testing coupons. Both the Concern-Relieving Intervention Group and the Control Group received coupons of the value of 50 Meticais. The High-Incentive Group received coupons of the value of 100 Meticais.

some of the stigma concerns by allowing test takers to conceal their real motivations for taking the test (Thornton, 2008; Swann, 2018). If that is the case, then the demand curve for an HIV test will jump discontinuously at the price equal to zero. The effect of the concern-relieving intervention on the WTP at a positive price can differ from that at a negative price. However, since both the Control Group and the intervention group received the same financial incentive, the design in this study is always valid in identifying the *existence* of the stigma-concern barrier to testing, regardless of the financial incentive's effect.

4.3 Heterogeneity by Belief Update

The concern relieving treatment is informational by nature. It is designed to change an individual's behavior by first changing his or her perceptions. An immediate inference is that the intervention will show the strongest effect on people who are open to and able to perceive the new information. Below I present suggestive evidence that this is the case.

We introduced a "concern re-assess" procedure to a subset of the concern-relieving group. The "concern re-assess" applied to a participant 15 minutes after the intervention was performed. (During the interval between the treatment and the re-assess, the participant was occupied by answering other survey questions unrelated to health or HIV.) In the "concern re-assess" session, the enumerator re-asked the questions in which the participant overestimated the stigma at first and learned the correct answers during the intervention. A participant could still give an answer suggesting high stigma concerns in the re-assess session, either due to lack of trust in the enumerator-shared information or due to the inability to process and remember the information. If a participant still overestimated stigma in the re-assess session, the enumerator would repeat the intervention one more time.

The "concern re-assess" allows us to observe participants' updates of beliefs in the immediate short term. Participants updating belief in the right direction were those who took the new information seriously and correctly. We call them "fast-updaters." Due to resource constraints, the re-assess procedure was implemented only in the provinces of Zambezia and Sofala. Two-thirds of the participants in the re-assess session updated their beliefs about stigma in the correct direction.

Regressions in Table 5 explore intervention heterogeneity between the fast-updaters and others. Column (1) replicates Column (2) of Table 3 to show the main intervention effect. Column (2) and Column (3) run the same regression separately on two subsamples: the one that we did not conduct a "concern re-assess" (Manica province) and the subsample that we did (Zambezia province and Sofala province). The two subsamples present very similar main intervention effects. Column (4) runs a regression that includes the interaction between concern-relieving intervention and fast-updater status. Since we were not able to measure whether a participant from the Control Group would be a "fast updater"; an individual's ability to digest information and update beliefs is not fully controlled for. The point estimate of the main effect shrinks to zero, and the intervention effect on the fast-updaters is almost twice the size of the

main effect in Column (3). Table 5 strongly supports the inference that the concern-relieving intervention is more effective on the fast updaters. (In fact, the main effect is entirely driven by them.)

Table 5: Heterogeneous Intervention Effect on Test Uptake by Belief Updates

	(1)	(2)	(3)	(4)
Sample	Full sample	Not Re-assessed Sample	Re-assessed Sample	Re-assess sample
Concern-Relieving Intervention	0.0771**	0.0766*	0.0895*	-0.0272
	(0.0326)	(0.0436)	(0.0539)	(0.0687)
Concern-Relieving Intervention × Fast updater				0.166**
				(0.0800)
Control Group Mean	0.207	0.181	0.241	0.241
Observations	754	413	341	341
R-squared	0.292	0.241	0.383	0.392
Constant	yes	yes	yes	yes
Controls	yes	yes	yes	yes

Notes: Standard errors in parentheses. Standard errors are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1. The control variables are the same as in Table 3.

Table 6 further explores intervention heterogeneity by four dimensions: gender, education level, wealth, and subjective risk of infection. I split the sample into two subgroups by each of the dimensions and run Equation (2). Coefficients obtained from the high-education subsample remain significant after adjusting for Multiple Hypotheses Testing (List, Shaikh and Xu, 2019). Table 6 also reports test of equality. The effect of the concern-relieving intervention exhibits strong heterogeneity by education levels: It is close to zero in the low-education group in contrast to 16.0 percentage points in the high-education one.

Table 6: Heterogeneous Intervention Effect on Test Uptake Across Subgroups

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Subgroup	Male	Female	Low educ	High educ	Poor	Wealthy	Low subrisk	High subrisk
Concern-Relieving Intervention (β_1)	0.0886	0.0495	-0.0148	0.160***	0.0197	0.112**	0.0996*	0.00944
	(0.0703)	(0.0402)	(0.0550)	(0.0468)	(0.0490)	(0.0532)	(0.0509)	(0.0583)
High-Incentive (β_2)	0.162**	0.114**	0.0925	0.181***	0.124**	0.103	0.140**	0.0395
	(0.0821)	(0.0517)	(0.0595)	(0.0594)	(0.0590)	(0.0654)	(0.0616)	(0.0680)
Control Group Mean	0.175	0.222	0.279	0.156	0.226	0.190	0.233	0.190
LSX adjusted p-value: β_1	0.814	0.797	0.962	0.029	0.977	0.422	0.487	0.884
LSX adjusted p-value: β_2	0.599	0.423	0.786	0.062	0.559	0.654	0.352	0.970
Test of equality p-value: β_1	0.541		0.004		0.129		0.166	
Test of equality p-value: β_2	0.531		0.207		0.780		0.195	
Observations	324	672	446	545	498	498	523	442
R-squared	0.016	0.003	0.001	0.025	0.005	0.006	0.003	0.008
Constant	yes	yes	yes	yes	yes	yes	yes	yes
Controls	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors in parentheses. Standard errors are clustered at the household level. Stars attached to the coefficients reflect unadjusted p-values: *** p<0.01, ** p<0.05, * p<0.1. This table also reports p-values that are adjusted for multiple hypotheses testing (16 tests in total, 2 coefficients by 8 subgroups) according to List, Shaikh and Xu (2019). Each pair of the intervention-effect coefficients are tested against equality. p-values of equality tests are reported. "Low educ" group has participants with below-median years of education (5 years of or less); "High educ" group with above-median years of education (6 years or more). "Poor"/"Wealthy" status are determined by the first principle components of ownership of 14 assets. The cut off value if 0.250. Participants with low subjective risk of infection ("Low subrisk") are those who believed themselves to be HIV negative. "High subrisk" group are participants were unsure of their own status or believed themselves HIV positive. In the regressions with controls, the control variables are the same as those in 3, while Column (1) (2) drop female indicator, Column (3) (4) drop education level, Column (5) (6) drop asset indicator, Column (7) (8) drop subject risk index.

Individuals with more education responded stronger to the concern-relieving intervention potentially because they were able to process the information better. This finding is consistent with the fact that the intervention is more effective on the fast updaters. Both dimensions of heterogeneity remind us that when applying informational experiments to a low-literacy population, participants' ability to understand the information can substantially affect the intervention's impacts.

4.4 Stigma and Test Uptake of Children

Till now, we have focused on adult participants and found that their stigma concerns have discouraged their test-seeking behavior. 71% of the adult participants are parents and make decisions for their children when it comes to HIV testing. If stigma concerns hold adults back from HIV tests for themselves, do they hold children back, too? The potential inter-generational effect of stigma concerns has important implications because a child's early experience in HIV testing can have prolonged effects not only on their short-term health status but also on their future habits about and attitude towards health behavior when they reach adulthood. This study can show the role of stigma concerns on children's test-seeking behavior with its children's coupon design.

At the stage of coupon distribution at the participant's home, each eligible child of the survey respondent was offered coupons to take an HIV test, regardless of the eligibility of the adult respondent. Each child received a coupon of the same value as the adult household members. Children's coupons were handed to the parent who answered questions on their behalf. In the analyses below, a child's group assignment is considered the same as the parent who answered questions on their behalf. We did not directly interact with children; in the Concern-Relieving Intervention Group, only adults received the intervention.

In Table 7 we report regressions similar to Table 4, Column (2), but with a sample of children. A child enters the regression in Column (1) if one of her parents overestimated stigma, and the child herself is eligible to receive a coupon for testing.

The child sample presents a test uptake rate of 30.1% under the control condition, higher than that of the adult sample. The high financial incentive displays a similar impact, 9.3 percentage points, on the child testing as on the adult testing. The concern-relieving intervention, on the other hand, does not play a significant role in raising the test uptake rate in children: in Table 7 Column (1), the point estimate of the intervention effect is 1.5 percentage points. Table 7 Column (2) examines how our interventions interact with parents' testing history (the parent was eligible for a coupon, the parent had been tested within 3 months, or the parent had been tested HIV positive). When the parent him or herself was eligible for a coupon, the concern-relieving intervention raises children's test uptake by 3.0 percentage point and the effect is still not statistically different from zero. Children's testing behavior is strongly correlated with their parents'. Parents who voluntarily sought tests for themselves within 3 months before our study are 12.6 percentage points more likely to take their children to be tested with our coupons. Both

Table 7: Concern-Relieving Intervention Effect on Children

Variables	(1)	(2)
	Test Uptake	
Concern-Relieving Intervention	0.0147	0.0298
	(0.0301)	(0.0366)
High-Incentive	0.0934**	0.137***
	(0.0363)	(0.0434)
Parent tested within 3 months		0.126**
		(0.0599)
Parent HIV positive		0.0538
		(0.0847)
Concern-Relieving Intervention ×		-0.0905
Parent tested within 3 months		(0.0789)
Concern-Relieving Intervention ×		0.0290
Parent HIV positive		(0.0944)
High-Incentive ×		-0.171*
Parent tested within 3 months		(0.0925)
High-Incentive ×		-0.0618
Parent HIV positive		(0.103)
Control Group Mean	0.301	0.301
Observations	3,519	3,519
R-squared	0.215	0.220
Constant	yes	yes
Controls	yes	yes

Notes: Standard errors in parentheses. Standard errors are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1. The control variables are: Indicator: a child is female (yes, no); Indicator: time of the most recent HIV test (never tested, tested more than a year ago, tested less than a year ago); Age: in years; Indicator: the participating parent is female (yes, no); Parent's Education: highest grade completed; Parent's Knowledge about HIV: Number of correct answers to the 15 questions testing HIV-related knowledge; The straight-line distance between the household and the testing clinic (in km); Square of the straight-line distance between the household and the testing clinic (in km); Indicator: the household ever go without food in the last 12 months (yes, no); Indicator: there is an HIV positive household member (yes, no); Asset ownership index: the first principal component of 14 asset-ownership indicators; Enumerator fixed-effects; Community fixed-effects. If any missing value exists for some variable "X," an indicator variable is created for variable X to flag missing status (1 if missing, 0 otherwise). The missing value of the variable X is replaced with zero. The variable X missing indicator variable is added to the set of control variables.

the concern-relieving intervention and the high incentives appear to be substitutes for a parent's active testing history. The interaction term between the parents tested within 3 months and either the intervention or the high incentives is negative and sizable.

Although we find that children's testing behavior is closely correlated with their parents', a parent's stigma concerns do not appear to be a major barrier when it comes to children's test uptake. The high test uptake rate among children in the Control Group and lack of effect of the concern-relieving intervention provide suggestive evidence. That the stigma barrier plays a less important role in children's testing than adults' testing may stem from the nature of the stigma. HIV infection is associated with some socially disapproved adult behaviors but not child behaviors; thus, parents believed that children are less prone to stigmatization. Another possible explanation is that even though children are equally prone to stigmatization, only the health status of children, but not their social relationship concerns, enters a parent's utility function. The experiment design in this study does not allow us to separate these different explanations. Learning stigma concerns' role in children's test uptake requires future work.

4.5 Demand for Testing among the Concerned and the Unconcerned

The analyses above have focused on the population that had excessive stigma concerns. We have shown that the concern-relieving intervention encouraged these individuals to take an HIV test and that the effect size is comparable to that of doubling the financial incentives. We also depicted their demand for HIV tests in the short term (14 days) in Figure 7 and discussed how the intervention effect fit into the demand curve.

In this section, we gauge the concern-relieving intervention from a different angle. Specifically, we try to answer the following questions: To what degree has my intervention helped "concerned" individuals catch up with the "unconcerned" individuals in taking HIV tests?

A naive approach is to compare the test uptake rate measured by coupon redemption of the Concern-Relieving Intervention Group (27.1%) with that of the "unconcerned" participants with 50-metical coupons (23.3%). This comparison would lead to the conclusion that the test uptake rate of the "concerned" after receiving the concern-relieving intervention will surpass that of the "unconcerned" people by 3.8 percentage points. This approach is biased, however, because the two groups are not comparable.[15] The "unconcerned" were more likely to have already tested shortly before the study, and as a result, were ineligible for coupons. Those who were "unconcerned" and received coupons was a sample that faced higher barriers beyond stigma concerns.

To get a comparable sample, consider everyone who did not know they were HIV positive at the time of 3 months before the study. We calculate their demand for an HIV test in the next three and a half months. Every one of them had the chance to take an HIV test without any financial incentives in the next 3 months, and if they chose not to, they received coupons from this study to take tests in the following 14 days.

[15] See Appendix Table A2 for comparisons between the concerned and unconcerned participants.

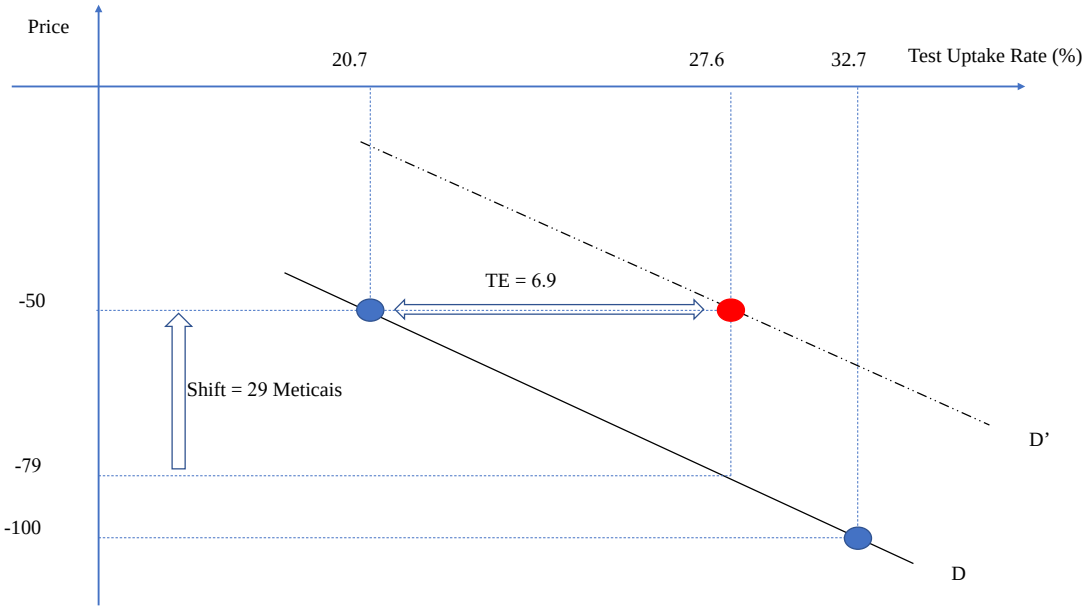

Figure 7: Quantifying the Intervention Effect on HIV Test Demand Curve

Notes: Curve D depicts the demand for an HIV test within 14 days among the "concerned" population. This study experimentally sets two price levels for a test: negative 50 Meticais (receive 50 Meticais conditional testing) and negative 100 Meticais (receive 100 Meticais conditional testing). The *x-axis* of this demand diagram is the percent of people that take the test.

To simplify the analysis, for now, we assume that learning one's HIV status does not affect one's belief about stigma in society. Thus, the "concern" status obtained from the study survey correctly reflects participants' "concern" status 3 months ago. We will later discuss the implications of our results if the assumption does not hold.

Table 8 summarizes the choices in the next three and half months of those who did not know they were HIV positive at the time of 3 months before the study, separately for the "concerned" and "unconcerned." 28.4% of the concerned and 31.3% of the unconcerned chose to take a test in the next 3 months. Those who did not take a test (71.6% of the concerned and 68.7% of the unconcerned) received coupons from this study. Of those who received coupons, when the coupon value is 50 Meticais, 20.7% of the concerned and 23.3% of the unconcerned took a test. When the intervention is applied in addition to the 50-Metical coupons, 27.1% of the concerned people took a test.

Table 8: Test Uptake of the Concerned and Unconcerned

Panel A: Concerned		
(1): Test uptake rate within 3 months before the RCT	28.4%	
(2) = 100% - (1): Entered the RCT	71.6%	
	Without intervention	With intervention
(3): Test uptake rate with 50-Metical coupons 14 days into the RCT	*20.7%*	*27.1%*
Test uptake rate during the 3.5 months at price = -50 Meticais (1) + (2)*(3)	43.2%	47.8%
Panel B: Unconcerned		
(4): Test uptake rate within 3 months before the RCT	31.3%	
(5) = 100% - (4): Entered the RCT	68.7%	
	Without intervention	With intervention
(6): Test uptake rate with 50-Metical coupons 14 days into the RCT	*23.3%*	-
Test uptake rate during the 3.5 months at price = -50 Meticais (4) + (5)*(6)	47.3%	-

Combining the numbers, the fraction of concerned people who would have taken a test in the 3.5 months at the price of negative 50 is 28.4%+ (1-28.4%)×20.1% = 43.2%. Similarly, the demand for a test in the 3.5 months period for the unconcerned group is 31.3%+(1-31.3%)×23.3%= 47.3% at the price of negative. Of the concerned people who also received our intervention and 50-Metical coupons, the test uptake rate within the 3.5 months period would be 28.4%+(1-28.4%)×27.1% = 47.8%. The relationships are depicted in Figure 8. In conclusion, when we

examine a 3.5-month period, the concern-relieving intervention makes the people concerned with stigma catch up with, and even surpass, those who were unconcerned.

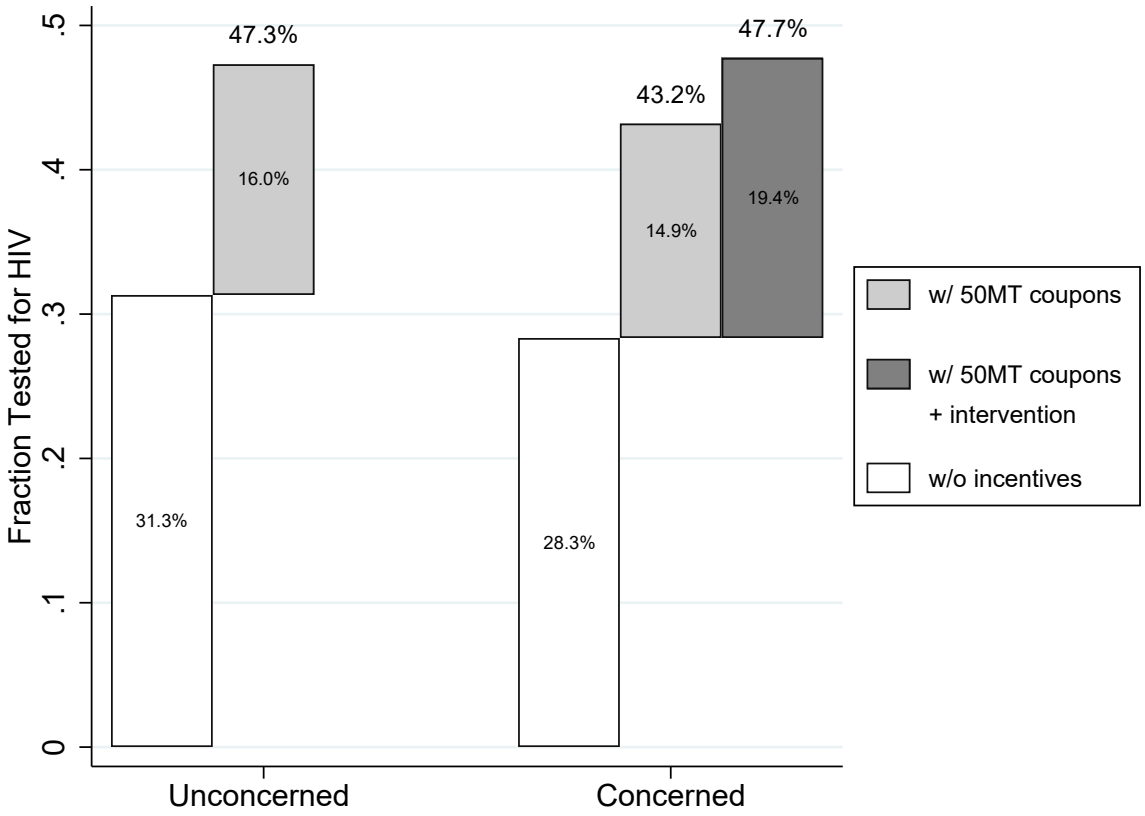

Figure 8: Demand for Testing among the Concerned and Unconcerned

Notes: The analysis sample of this figure is all survey respondents that were eligible for a coupon or were tested for HIV within 3 months before the recruitment survey. The *y-axis* is the HIV test uptake rate.

Now consider how violations of the assumption would affect this result. If learning one's HIV status makes people believe that there is less stigma, then some people who tested for HIV before the study (row (1) of Table 8) and were assessed as "unconcerned" in the study survey were in fact "concerned" 3 months before the study. That means the test uptake rate within 3 months before the study for the "concerned" should be higher than 28.4%, while, for the "unconcerned," it should be lower than 31.3%. As a result, with the intervention, the 3.5-months test uptake rate of the concerned should be higher than 47.8% and that of the unconcerned lower than 47.3%. Correcting this bias would suggest that a previously "concerned" person with the concern-relieving treatment became even more likely to take an incentivized HIV test than an "unconcerned" person.

5 Conclusion

This paper analyzed a randomized control trial to identify the role of stigma concerns in hindering HIV testing and to quantify the stigma barrier.

We obtained local stigma environment measures of the study communities one year before the RCT and used these measures to construct an intervention to experimentally mitigate individuals' concerns for stigma. Participants with excessive stigma concerns were randomized to receive the concern-relieving intervention; in this intervention they are informed of the true stigma environment measures of their communities that suggested lower-than-expected stigma. We then tracked participants' test-seeking behavior with testing coupons.

This paper first establishes evidence that the stigma concerns are a barrier that has caused people to avoid taking an HIV test. Participants from the Concern-Relieving Intervention Group took up HIV tests 7.7 percentage points more or by 37% more, than those from the Control Group.

Moreover, the experiment design allowed us to give the stigma barrier a dollar value. We introduced study groups with different levels of monetary incentives for HIV testing. The Control Group and the Concern-Relieving Intervention Group received coupons of 50 Meticais (2.25 dollars by PPP, equivalent to the daily cost-of-living). In an additional study group, the High-Incentive Group, participants received no intervention but coupons of 100 Meticais. The Control Group and the High-Incentive Group locally pin down the demand curve for HIV testing. In the demand framework, the concern-relieving intervention raised individuals' willingness to pay (WTP) for an HIV test by 29 Meticais (1.30 dollars by PPP, or more than half of the daily cost-of-living).

This paper conducted additional analyses to depict the role of stigma concerns in HIV testing. Our concern-relieving intervention is most effective on those who were able to perceive the information immediately or those with more years of educations, which suggests that participants' capacity to process new information substantially affects the success of this informational intervention. In exploring children's behavior, the study shows that children's test uptake rate under the control condition is higher than that of their parents' and that stigma concerns do not appear to play a significant role when parents make test-seeking decisions for their children. Combining self-reported history with the coupon redemption, we found that the simple concern-relieving intervention is effective enough to help individuals with excessive concerns take HIV tests at a similar rate as those in the "unconcerned" group.

In response to the HIV epidemic, global donors and national governments have launched a wide variety of campaigns in Sub-Sahara Africa. Many of these contain informational components that disseminate knowledge about the disease and promote supportive attitudes towards the infected population. This paper suggests a new piece of information, the social stigma measures, that holds much promise in promoting healthy behavior regarding HIV prevention and treatment. Building on the fact that the stigma environment has continuously improved in Sub-Sahara Africa, I showed that letting people learn the supportive, low-stigma environment of

their community has a large positive impact on the public uptake of HIV tests. This paper calls for policymakers to pay particular attention to the social stigma barrier when advancing public health programs related to HIV. The informational intervention designed in this study can be scaled up in a broader population at a reasonable cost and can fit into campaigns fighting HIV.

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Appendix

Online Appendix