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Journal of AIDS and HIV Research

Full Length Research Paper

AIDS health campaign impacts varies with sexual healthy practices and literacy aptitude

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Health communication campaigns along with the targeted social health indicator such as the at-risk group can make an impactful difference in preventive care and chronic disease health maintenance. The logistic regression technique is employed to examine if Rwanda's health media campaign impacted household health behavior and whether this impact was influenced by literacy aptitude and current sexual health practices. Interactive effects of health campaigns were found on household sexual behavior among at-risk households in Rwanda. Tests on model validity and reliability favor the models and give statistically greater confidence in the results.

Key words: HIV, AIDS, health campaign, HIV campaign, AIDS campaign.

INTRODUCTION

Effective health campaigns are key to effect a positive reception of health promotion messages by the population. Health communication is increasingly recognized as a necessary strategy to improve personal and public health (U.S. Department of Health and Human Services, Health Resources and Services Administration, 2015). As described by Schiavo (2007), health communication is a multifaceted and multidisciplinary approach to reach different audiences and share health-related information to influence, engage and supporting individuals, communities, health professionals, special groups, policymakers and the public to champion, introduce, adopt, or sustain a behavior practice or policy that will ultimately improve health outcomes. HIV/AIDS carries with it a stigma that adds to the challenges in communicating health messages to those affected and getting them to engage in preventing and treating infections. HIV counseling and testing are essential to its

prevention, treatment, care and support. Evidence from studies have demonstrated that if those with HIV start treatment early soon after detection, they will live healthier and longer lives and are less likely to transmit HIV to their partners (Cohen et al., 2016; Mendez-Lopez et al., 2019).

Health communication campaigns, if constructed strategically and guided by principles and theories of effective communication, could be successful in conveying health messages to large groups of population which would reinforce healthy practices and public health strategies.

As such, they are part of health promotion tools and are becoming important to prevent and control communicable diseases (Sixsmith et al., 2014). Determined, resilient, empowered, AIDS-free, mentored and safe (DREAMS), for example, is a comprehensive public-private partnership that used communication messaging and

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campaign effectively on some aspects, such as social support (Gourlay et al., 2022). DREAMS participants received 15% percentage points more social support.

Health campaigns are typically used to increase awareness of health problems (Atieno, 2019). Their primary function in healthcare involves the dissemination of relevant and important health information to target groups. Diffusion of health messages through health promotion programs and campaigns can create awareness of an issue, change attitudes toward a health behavior, and encourage and motivate individuals to follow recommended health behaviors (Fertman and Allensworth, 2017). Although health communication alone cannot change behavior, understanding its function and how its principles are used in a health promotion program will increase its likelihood of achieving desired positive behavioral change.

The content of the campaign also depends on the health literacy of the target audience as that is key to the receptivity of health messages. Health literacy skills are becoming a major factor in determining a successful health outcome (Fertman and Allensworth, 2017). Health literacy, according to the U.S. Department of Health and Human Services (2000), is the "degree to which an individual can obtain, communicate, process and understand basic health information and services to make appropriate health decisions." Health literacy goes beyond reading and writing skills, it includes the ability to understand and assess health information to make informed decisions about healthy behavior, self-care and disease management (Zarcadoolas et al., 2005). When people can comprehend and act on health information, they are better able to manage their health conditions and make better health decisions (Rothman et al., 2004). Bekele and Fekadu (2020) found differences in testing were across important sociodemographic variables, such as education levels.

Acting on health information, however, depends on risk attitudes and risk perceptions. Risk perception oftentimes drives health behaviors. A randomized trial on communicating the risk of sexually transmitted infections (STI) showed that risk perception influenced taking STI testing and using condoms. Thus, effective communication using appropriate campaign materials could affect behavioral change.

In this study, the changes in health behavior were evaluated in response to HIV campaigns undertaken by the Rwandan government. The Rwandan government undertook efforts to improve population health through various policies and programs. To effect changes, it launched several health campaigns. There is good information collected specifically on health campaign messages that allows us to measure the effectiveness of health campaigns. Rwanda's success in health parameters could be attributable to its effective health communication campaigns that focus on health prevention.

HIV has been the focus of many governments because of the death rates and the stigma associated with it. Hence, it is extremely important to devise health campaigns to effect positive changes. Understanding key components of health campaigns along with the health social determinants would inform future campaigns.

CURRENT LITERATURE ON HIV CAMPAIGNS

Mass media campaigns have often been used for HIV prevention by raising awareness, imparting knowledge, and increasing rates of testing. Using a randomized control design, the study by McOwan et al. (2002) suggests that providing detailed information about accessing testing services was key to increased HIV testing. Their target group was gay and bisexual men in London, particularly especially those of Black and South European Origin and those under the age of 25 years old. Media campaigns have helped improve sexual life. People living with HIV/AIDS in 32 hospitals providing HIV care were surveyed to examine the impact of French mass media national prevention campaigns on attitudes and sexual risk behaviors (Peretti-Watel et al., 2005). Those surveyed reported a higher probability of using condoms compared to 6 months before the campaigns. Another study was conducted by Whittingham et al. (2008) on a group of 185 students from two schools in the Netherlands. The random assignment experiment assessed intentions and behaviors toward STI and AIDS control. A pre-and post-TV campaign exposure test against a control group revealed a positive effect of the health campaign on female student risk perception, intention to buy and carry condoms, and intention to engage in a discussion of condom use. However, the TV campaign did not have a positive impact on perceived personal responsibility, intentions to use condoms with new partners, and anticipated regret. Mass media tools other than TV have been used in HIV campaigns and those include brochures, posters and newspapers for example compared TV, newspapers and posters.

These studies clearly show less focus on certain social determinants that could have been taken into account for campaign effectiveness. Social determinants include wealth, education attainment, literacy, sex of the household head, household assets, knowledge about HIV, knowledge of HIV testing place, and distance to HIV testing place. As discussed previously, people's response, and thereby the medium's effectiveness, depends on underlying individual socio-economic factors.

HIV health and campaign among the Rwandan population

Healthcare is seen as one of the pillars of any sustainable economic development. Many development

economists recognize that a lack of good health is linked to poor labor productivity (for example, Russell, 2004). Development policies in developing countries need to promote health, which could improve economic productivity. As health campaigns become an important tool for health promotion all over the world, Rwanda's government has emphasized informing and educating its population about better preventive care.

Rwanda made enormous progress in many areas since the 1994 genocide, which devastated the country's economy and population. The genocide also negatively impacted Rwanda's development indicators. The health sector, however, is one key area in which they achieved considerable progress resulting in Rwanda becoming one of the major health sector reformers in Sub-Saharan Africa.

Much progress has been made regarding HIV incidence in Rwanda. There was a drop from 13% in 2000 to 3% in 2011 (from the 2020 Vision booklet). Even though it is a big achievement, the numbers still remain pretty high. Of the 220,000 people living with HIV in 2014 to 2015, about 3,300 died from AIDS that included close to 1,000 children. With a GNI of $1,720, Rwanda spends $52 on health. Despite being a developing country, 99% of pregnant women with HIV have visited a clinic or hospital for antenatal care, a commendable achievement.

Rwanda has shown significant progress in the health prevention of STIs since the year 2000 points to the government's expansive role in health policy and programs. Antiretroviral use among AIDS patients has been increasing since 2020 (World Health Organization, 2018). Rwanda also has fewer infectious diseases, such as malaria, compared to many other countries in Sub-Saharan Africa. It is estimated that 82% of pregnant women with HIV received antiretroviral and 77% of infants born to HIV women received anti-virologic testing within two months of birth, in 2020. The rate of transmission from mother to child, including breastfeeding, is just 7.6%. Life expectancy at birth is 68 years (2015-2020, UNPOP). Rwanda has twice the number of people living with HIV compared to its neighbor Burundi. However, the rate of mortality due to AIDS is almost half that of Burundi, according to the UNDP dataset for 2019.

Vision 2020 was a government-administered development program launched in 2000 by the Rwandan government under President Paul Kagame to make itscitizens healthier, more educated, and more prosperous[1]. 2020 vision pillars are to improve the general welfare of the population, and improving the education system and health services[1]. Keeping in mind the important role of social determinants of health, the country's health policies were developed with multisectoral strategies along with effective health communication campaigns targeting the economically deprived population. Social determinants refer to conditions in which people are born, work and live (Health Determinants Review). Social determinants were considered to improve the quality of life by increasing access to health services to the poor. Since then, Rwanda has made tremendous progress in improving the health of its population. For example, life expectancy increased from 51.2 years in 2002 to 66.7 years in 2016 (Minister of Health, Health determinants Review).

To achieve health equity, the health plan also focuses on the creation of policies, and institutional and legal framework for the protection of the vulnerable population. According to the Rwanda Minister of Health, Rwanda's strategy also highlighted the promotion of community involvement in policy making and its implementation, while also targeting social demographic groups, such as those financially deprived. By decentralizing the policymaking and implementation, the government increased community participation; formed a dynamic policy and regulatory framework for civil society, private industry, and other stakeholders programs aimed towards poverty reduction.

Rwanda is one of the very few countries in Sub-Saharan Africa to achieve all the 2015 Millennium Development Goals (MGD). The country took ambitious social reforms mixed with local solutions implemented by its government. It focuses on health and key social indicators to improve its people's lives. Rwanda's success following its health strategies coupled with its health communication campaign has put Rwanda on the global map as one of the few countries that overcame difficult odds.

METHODS

Data

Demographic and Health Surveys (DHS) are cross-sectional household surveys of Rwandan households collected in 2015. Households in the sample are selected based on a stratified two-stage cluster design. These have large sample sizes and are represented at the national level, residence level (urban-rural), and regional level, such as states. DHS program works with individual governments to collect survey data on several topics, including population and health.

DHS surveys used four types of model questionnaires to collect data. Household questionnaires collect information on the characteristics of the household's dwelling unit including the characteristics of residents and visitors. According to DHS site, it surveys identify members of the household who are eligible for an interview. Eligible candidates are then interviewed based on individual gender questionnaires. The Biomarker questionnaire collects biomarker data on the households' residents including children, women and men. Biomarkers include the body mass of children, women, and men to determine their nutritional status, hemoglobin level, and capillary blood sample used for HIV testing. Optional questionnaire modules are available for topics that are not covered in the model questionnaires. Interviews are conducted only based on voluntary informed consent (The DHS Program - DHS Questionnaires, n.d).

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[1] https://africanfutures.files.wordpress.com/2016/06/rwanda-vision-2020-revised-booklet.pdf

Table 1. Variable descriptions.

Variable description	Code variable
Behavior changed by limited sex partner to one	0 = no; 1= yes
Read about AIDS in brochures/posters (RABRPOS)	0 = no; 1= yes
Any grade school education (EDUA)	0 = no; 1= yes
Avoid use condom for sex (UCS)	0 = no; 1= yes
Avoid sex prostitutes (ASP)	0 = no; 1= yes
Avoid sex with same-sex (ASH)	0 = no; 1= yes
Avoid partner who have many partners (APWHP)	0 = no; 1= yes
Number of Sex partner in life (NSPL)	1 to 6

* Yes is coded as 1 and no as 0. Hence means column represents the proportion who indicated yes.
Source: Demographic and Health Surveys (DHS), https://statistics.gov.rw/datasource/demographic-and-health-survey-dhs

The DHS surveys are two-stage surveys

Stage one is a systematic sampling with probability proportional to the EA (enumeration areas) size. The second stage is a systematic sampling of equal probability and fixed size across the EAs. In each EA, a set number of households are selected at random. The two-stage cluster sampling is used in most Demographic and Health Surveys (DHS) in form of interview surveys of household members in a specific age group (Aliaga and Ren, USAID).

DHS inclusion and exclusion criteria

DHS has inclusion criteria, which are the attributes of subjects that are necessary for their participation in the survey. Inclusion criteria is an important function that controls for specific confounding variables, such as the use of contraceptives, including all family members of the same household, including all houses in a household group, avoiding excluded parts of the village, married or unmarried, number of partners, pregnant women, and type of work for women, education level. All individuals should have an equal chance to be included as eligible at one place regardless of their ability to participate in the survey carried out on the same day in all clusters.   Eligibility for individual interviews is women of reproductive age between 15 to 49 years old and age 50 to 54 years old, according to DHS model questionnaire overview at DHS.program.com. Individual questionnaires general information such as fertility, mortality, family planning, marriage, reproductive health, child health, nutrition and HIV/AIDS.

An exclusion criterion was also set to ensure full participation. For example, subjects could be excluded for failure to adhere to pre-test requirements, prison location for HIV testing if included by chance, mobile household members, sick individuals, military members, infection and insecurity areas.

The confidentiality of respondents is given particular emphasis. Surveys are anonymous. In the case of HIV testing, the DHS policy stipulates additional steps. It specifically requires that the primary sampling units PSU and household IDs are scrambled in the final data. Furthermore, confidentiality guidelines require the complete destruction of all intermediate documents that could potentially be linked to a household. Thus, the data is reliable.

Health behaviors among households

The key outcome variable was whether they changed their behavior by limiting themselves to only one sexual partner. The household response was coded as either yes or no to a question on whether their behavior changed specifically after reading about or seeing a health campaign on AIDS on brochures and/or posters. Variables of interest to explain this health behavior change were educational attainment, exposure to health campaign messages, and current sexual behaviors. Household education was recorded in the survey as having no education, elementary, secondary, or tertiary education. Since the campaign was simple enough to reach the entire population, we created a binary variable as no education and any education, which could be elementary, secondary, or tertiary education. Each health campaign material focused on different aspects of HIV prevention. Current sexual practices included in this study were using a condom during sex, avoiding sex with prostitutes, avoiding sex with same-sex individuals, avoiding having sex with a partner who has many partners, and the number of sex partners in life (Table 1).

Methodology

The logit model is better suited when the outcome variable is dichotomous, that is, yes or no. The logit model uses the cumulative distribution function that follows a logistic distribution. Logistic regression, however, comes with several assumptions. The true conditional probabilities are a logistic function of the independent variables. The regression model assumes that all-important variables are included and that these variables are independent, measured without error, and are not linear combinations of each other. Therefore, after the results section, we present evidence of the validity of the econometric model.

The desired relationship for individual i in a logistic regression model is:

$$y_i = \beta + \beta_1 E + \beta_1 R + \sum_{3}^{7} \beta_k M_k + R * \sum_{8}^{12} \beta_j M_j + \varepsilon$$

where the outcome variable is the behavior change of limiting to only one sexual partner E is the educational attainment; R is having read health campaign brochures, and M represents one of five current healthy behavior practiced by households. The healthy practices include avoiding condom use during sex (UCS), avoiding sex with prostitutes (ASP), avoiding sex with homosexuals (ASH), avoiding having sex with a partner who has many partners, and number of sex partners in life (NSPL). Each of these healthy practices interacted with the binary variable of whether the respondent read about the campaign or not.

Table 2. Log odds of changing behavior in response to health campaigns (N=2,073).

Behavior changed only limited to a sex partner	Coefficient	SE
Read about AIDS in brochures (RABRPOS)	0.36	0.343
Education (EDU)	-0.1	0.9
Avoid sex with homosexuals (ASHS)	0.42	0.9
Avoid sex prostitutes (ASP)	0.92**	0.36
Use condoms during sex (UCDS)	0.47***	0.15
Avoid partners who have many partners (NSPL)	0.17**	0.05
Interaction of read about AIDS in a brochure with		
EDU	-0.64	0.17
ASP	-0.27	0.42
UCDS	-0.42*	0.21
NSPL	0.66**	0.27

LR chi (14) =82.08. prob>chi (2) =0.001. *, **, and *** significance at 1, 5 and 10%, respectively.
Source: Demographic and Health Surveys (DHS), https://statistics.gov.rw/datasource/demographic-and-health-survey-dhs

In terms of probability, the logistic regression model is:

$$log\left(\frac{P}{1-P}\right) = \beta + \beta_1 E + \beta_1 R + \sum_{3}^{7}\beta_k M_k + R * \sum_{8}^{12}\beta_j M_j + \varepsilon$$

where p is the probability of $y_i=1$. The marginal effects are then computed from the logit estimates.

RESULTS AND DISCUSSION

Logistic regression estimates on the behavior change of limiting to one sex partner are presented in Table 2. Avoiding sex prostitutes (ASP) has a statistically significant 0.92 lower log odds of limiting to one sex partner. Interacting ASP with health messages, however, was not statistically significant. This implies that those who avoid sex prostitutes and have read about preventing AIDS do not show behavior change in limiting the number of sex partners. Households that do not elicit prostitution do not seem to gain from receiving health messages. Using condoms during sex (UCDS) significantly raises the log odds of limiting to one sex partner, 0.47 higher log odds. Surprisingly, the interaction term indicating reading about AIDS and using condoms during sex (UCDS) results in a decrease of 0.42 log odds in limited to one sex partner. Perhaps, individuals who got the message that AIDS patients should use condoms during sex might have thought that using condoms could avoid getting HIV when having multiple sex partners. Those who avoided sex with those who have multiple sex partners in life (NSPL) have significantly higher odds of limiting to only one sex partner. Specifically, 0.66 log odds of limiting to one sex partner. The interaction variable reading about AIDS health messages and NSPL showed greater odds of significant impact on behavior change limiting to one sex partner. Perhaps, health messages need to target specific household risk groups for behavior change.

Having read about AIDS in brochures /posters (RABRPOS) and educational attainment are not statistically significant. However, household behavior of limiting to one sex partner is significantly modified by health campaigns among those who use a condom during sex, avoid sex prostitutes, avoid sex homosexuals, and avoid having sex with partners who have multiple partners.

Besides the log odds, we estimate the marginal estimates of how these campaigns predict behavior change. Marginal effects show the change in the probability of outcome from zero to one in response to a unit change in the value of an independent variable. Here the outcome is behavior change of limiting to one sex partner.

Households with a higher number of sex partners in life and who have a higher exposure to health campaigns will have a 36% higher likelihood of changing their behavior. Households with many sexual partners are more receptive to health campaigns when compared to households with one sexual partner. That is, they have a 36% higher likelihood of changing to sexually healthy behavior. There is a 41% higher likelihood of behavior changed by households the avoid prostitution after exposure to health campaigns. Households with higher condom use after exposure to health campaigns have a twenty eight percent likelihood of their behavior changing.

Interaction of health campaigns along with existing better sexual behavior among households' results in bigger gains on changing household behavior of limiting to one sex partner (Table 3). This could indicate that households exposed to AIDS will have a greater likelihood of behavior change post-health campaigns. Overall, behavior leading to contracting HIV when interacted with health campaigns shows positive influence that is

Table 3. Predicted marginal effect of interactions terms.

Variable	Margins	SE (Delta method)
RABRPOS *NSPL	0.36***	0.03
RABRPOS *ASP	0.41**	0.057
RABRPOS *UCDS	0.28***	0.016

Change of limiting to one sexual partner was regressed on explanatory variables. *, **, and *** significance at 1, 5 and 10%, respectively.
Source: Demographic and Health Surveys (DHS), https://statistics.gov.rw/datasource/demographic-and-health-survey-dhs
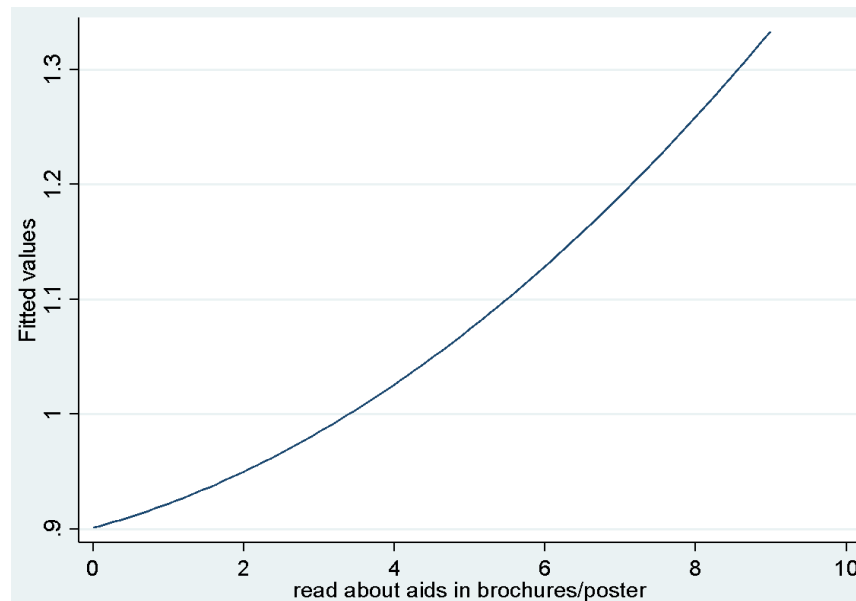
Figure 1. Fitted values for logistic regression.
Source: Demographic and Health Surveys (DHS), https://statistics.gov.rw/datasource/demographic-and-health-survey-dhs

statistically significant.

Model reliability and validity

We already learned how to compare models using the deviance, but the pre-diagnostics test helps us see if our model can work. One technique for assessing pre-diagnostic tests in a logistic regression model is to examine the fitted curve, which shows if the model is a good fit.

A pre-diagnostic test using logistic regressions helps us to explore the data visually as shown in Figure 1. The dependent variable that is, limiting to one sexual partner is plotted against the variable read about AIDS on brochures/posters. The resulting logistic regression curve is shown on the scatter plot. It shows the predicted probability of a household changing their behavior for a given level of household reading about AIDS on brochures/posters. The logistic curve is increasing. Therefore, in logistic regression, larger values of covariates that have positive coefficients will tend to increase the probability that Y = 1. The curvature shows that the model is well-fitted with an odd value going from zero to infinity.

Other model tests run include Pearson's goodness of fit test (Table 5), Linktest (Table 6), Hosmer-Lemeshow Chi-square (Table 7), and another sensitivity test. Pearson's goodness of fit test in Table 5 shows that the covariates are weakly correlated with a p-value greater than 5%. Thus, the model specification is adequate and a good fit. In Table 6, the link test reveals no specification error; therefore, the link test favors the logistic specification. The predicted value from the model is a statistically significant predictor of the model. The predicted values square are statistically insignificant, which indicates the link test is no longer significant. Therefore, the presence of interaction terms in our logistic model is justified since

Table 5. Pearson test for goodness fit for logit model.

Item	Value
Number of observations	4546
Number of covariate patterns	1061
Pearson chi^2(1022)	8.92
Prob> chi^2	0.5799

Source: Demographic and Health Surveys (DHS), https://statistics.gov.rw/datasource/demographic-and-health-survey-dhs

Table 6. Detection of specification error.

Logistic regression parameter	Coeff	Std. error	z	P-value
Predicted values from the model	1.05***	0.373	2.82	0.0001
Predicted values square	0.023	0.156	0.15	0.882
Constant	0.027	0.23	0.11	0.91
LR chi (2)	66.22***			0.0001
Number of observations	2802			

Source: Demographic and Health Surveys (DHS), https://statistics.gov.rw/datasource/demographic-and-health-survey-dhs

Table 7. Post-estimation Hausman test for goodness fit.

Item	Value
Number of observations	3,390
Number of covariate patterns	10
Hosmer-Lemeshow chi2(8)	8.92
Prob> chi^2	0.3489

Source: Demographic and Health Surveys (DHS), https://statistics.gov.rw/datasource/demographic-and-health-survey-dhs

it gives a better model in terms of model specification. In other words, our model is properly specified. The likelihood ratio chi-square of 66.22 with a p-value of 0.0001 shows that the model fits statistically better than the baseline model, which is the model with no predictors. Hosmer-Lemeshow Chi-square is not statistically significant, which indicates our model is a good fit at 5% level (Tables 7).

Sensitivity and specificity give us an indication of how much confidence we can put in our model testing. These two specifications tests assess whether the total analysis including datasets is valid. The first sensitivity test predicts that there are 3,091 households that likely respond positively to behavior changes compared to a total of 3,093 (Table 8). About 99% of households correctly respond to the behavior change questions, that is, the proportion of households who did change their behavior is correctly classified. For the specificity test, there are 4 households out of 297 who did not respond positively to behavior changes (Table 8). Among households who did not change their behavior, the specificity test is around 1%. That is the proportion of households who did not change their behavior correctly. The overall predicted positive response is 3,384.

In summary, the results show there are positive interactive effects of health campaigns on household sexual behavior among at-risk households in Rwanda. Tests on model validity and reliability favor the models and give statistically greater confidence in the results.

Conclusion

Rwanda's health care has been making good strides to achieve better care for all its citizens. Part of Rwanda's health strategy focuses on preventive care in which health campaigns take up a big role. The central question was whether health campaigns influenced health behavior. This study used nationally weighted representative data that reflects the proportion of women as head households experiencing different sexual partners and its associated factors at the national level

Table 8. Sensitivity and specificity test for logistic model: Behavior changed by limiting sex partner to one.

Classified	Actual		
	True (D:+)	False (~D:-)	Total
+	3091	293	3384
-	2	4	6
Total	3093	297	3390

Source: Demographic and Health Surveys (DHS), https://statistics.gov.rw/datasource/demographic-and-health-survey-dhs

and regional levels.

The results of this study show that a health campaign by itself is not enough to achieve better health promotion. Health campaign messages have a larger influence on those already practicing healthy behaviors. Thus, there needs to be a different health campaign messaging for those not following sexually healthy practices. Health campaigns based on the brochures/posters, along with at-risk health groups seem to have a positive impact on the changed health behavior. However, to achieve greater uptake of preventive medicines, health agencies should work with community outreach or social workers to address misperceptions and attitudes, especially among the younger generation (Michielsen et al., 2014). Rwanda's health policy is getting better because of its targeted health campaigns, and decentralized decision-making. Health policy should empower local health practitioners and others to engage in health campaigns centered around preventive care. Another important consideration in targeted messaging are social determinants, such as educational attainment and health exposure.

Rwanda has shown some remarkable progress but still has a long way to go. Immunization and early disease detection tools should be more available to economically-deprived communities. Pre-exposure prophylaxis (PrEP) uptake, for example, could be increased by focusing on HIV at-risk population (Kambutse et al., 2018).

There are, however, some limitations of the findings. Using cross-sectional data makes it difficult to establish a causal relationship between household behavior change and their predictors. Although DHS collects a wealth of information at the household and individual level, some socio-cultural factors that impact household behavior change were not queried or collected.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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