Mass Media Exposure and Family Planning in West African Adolescents
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Introduction:

Globally there are 222 million women who want to space or limit their pregnancies but are not currently using contraception. [1] [2] As a result, each year there are millions of unintended pregnancies worldwide. Furthermore, pregnancies that are spaced too closely or that occur in high parity women are associated with increased maternal mortality and morbidity, and carry a greater risk of pre-term birth, low birth weight, and neonatal mortality. [3] [4] [5] Unintended pregnancies may also result in women seeking unsafe abortion, especially in countries where access to safe legal abortion is highly restricted, which is also associated with significant maternal morbidity and mortality. [6] [7] Approximately 13% of all maternal deaths are due to abortion complications. [5] Furthermore, the vast majority of maternal deaths occur in poorer regions; it is estimated that as many as 99% of all maternal deaths occur in developing countries. [5] Contraception has been demonstrated to be an effective strategy for reducing maternal mortality. Ahmed and colleagues estimated that in 2008, 44.3% of maternal deaths were averted by contraceptive use. [5] While the provision of contraception requires substantial investment from donors and governments, the resources saved through the prevention of unintended pregnancies, as well as the potential morbidity and mortality associated with such pregnancies, make investments in contraception incredibly cost-effective. In their 2012 report, *Adding It Up*, Singh and Daroch estimated that while it would cost $8.1 billion to provide contraceptive services to all women in the developing world who are in need of a modern method, doing so would save approximately $11.3 billion in maternal and newborn health services. [1] Additionally, unmet need for contraception disproportionately affects poorer, uneducated, and rural women; failing to meet the contraceptive needs of such women further

perpetuates social and economic inequality. [1] Lastly, giving families the power to plan the number and timing of pregnancies empowers women, leads to increased female participation in the labor force, and is associated with higher household earning potential and school enrollment. [2] [8]

While global unmet need is high, regional disparities are well-documented. Unmet need and total fertility rates (TFR) remain especially high in Sub-Saharan Africa. Even within Sub-Saharan Africa disparities exist. West Africa in particular has not attained the same levels of contraceptive prevalence and fertility reduction as many of its neighbors. [1] [9] [10] The proportion of married women with unmet need for modern contraception in West Africa is 30%, much higher than the rest of the developing world, where unmet need is estimated to be approximately 18%. Furthermore, in West Africa, the modern contraceptive prevalence rate (MCPR) – or the proportion of married women currently using a modern method of contraception – is extremely low, at about 9%. By comparison, in East Africa, MCPR is estimated to be around 27%. [1] Not surprisingly, the differences in MCPR are mirrored in approval of family planning, with couples in East Africa being much more accepting than couples in West Africa. [10] The reasons for these differences are complex and multifactorial: Cleland et al. postulate that the lag in West Africa is due to lower availability and access to contraceptives than in East Africa. The authors also theorize that lower rates of education among women in West Africa may play a significant role. [10] Others have argued that the redirection of donor and government resources to HIV/AIDS has resulted in decreased funding for family planning services. Provider stigma and other sociocultural factors are also thought to be possible causes. [11] There is renewed focus on the region as a result of the Ouagadougou Partnership,

formed in 2011 in an effort to reinvigorate family planning (FP) in Francophone West Africa. [11] [12] Despite this renewed commitment, there is still progress to be made.

In addition to regional disparities, differences in modern contraceptive use according to socio-demographic characteristics persist. In particular, use of family planning among adolescents is low relative to older cohorts. [13] Adolescents (defined in this study as women aged 15-19) in West Africa have especially low contraceptive prevalence. Of note, there are significant differences in contraceptive use between married and unmarried adolescents. [10] However, because of social stigma and other contextual issues, it can be difficult to obtain adequate and accurate data on sexual activity and use of family planning among unmarried sexually active adolescents, and marital status is often used as a proxy for sexual activity and thus risk for unintended pregnancy. Therefore, our study focused solely on married adolescent women.

There are a number of factors that contribute to low MCPR in adolescents. These include, but are not limited to, lack of comprehensive sexuality education, lack of knowledge, fear of side effects and infertility, cost, prohibitive policies preventing the provision of contraceptives to adolescents, stigma on the part of partners, providers, and parents, as well as other socio-cultural influences. [14] [15] [16] [17] Additionally, in West Africa rates of teen marriage are particularly high, which is associated with earlier initiation of childbearing. [7] [17] According to a 2013 UNFPA report, in West Africa 28% of women aged 20-24 reported a birth before age 18, and 6% reported a birth before age 15. [7] There is some controversy regarding the increased risk of maternal mortality among adolescents. Nove et al. showed that women ages 15-19 have higher risk of maternal mortality than women 20-24, but a greater risk was demonstrated in women over 35. The authors theorized that the increased number of maternal deaths among adolescents may

be due to poorer healthcare access, as adolescent pregnancies are more likely to occur among poorer and less-educated women. Yet it can also be difficult to obtain accurate data regarding maternal deaths among adolescents in the developing world. [18] However, despite the complex picture around maternal mortality in adolescence, the evidence does suggest that adolescent pregnancy carries greater obstetric risk and is associated with higher maternal morbidity and increased neonatal mortality. In their analysis of adolescent pregnancy in 29 countries, Ganchimeg et al. found that compared to women ages 20-24, adolescents had a greater risk of eclampsia, puerperal endometritis, and systemic infections, even after adjusting for certain socio-demographic characteristics. [19] Additionally, there is a greater risk of low birth weight and preterm delivery among children born to adolescent women. [19] [20] Fall et al. also found that children born to women younger than age 19 had increased risk of 2-year stunting and lower rates of secondary school completion. [20] Furthermore, pregnancy and childbirth complications are the leading cause of death among adolescent women in low and middle income countries. [15] [17] Women who give birth in adolescence are also less likely to complete their education, resulting in lower lifetime earning potential. [7] [15] [17] Adolescent pregnancies are also more likely to occur among women who are poorer, less educated, and who live in more rural areas. [7] [18] Thus providing voluntary family planning to adolescents would not only help mitigate the health risks they face from early and unintended pregnancy, but also has the potential to provide them with greater social and economic opportunities.

Country Context

While West Africa is a diverse region and country context is an important consideration in all family planning programming, Burkina Faso and Senegal were chosen for this study based on availability of data and demographic similarities. Burkina Faso and Senegal are both countries

in Francophone West Africa with predominantly Muslim populations (94% in Senegal; 60.5% in Burkina Faso), as well as large youth populations. In both countries, approximately 40-45% of the population is under age 14, and 20% is between the ages of 15 and 24. Burkina Faso has a slightly larger population of approximately 18.9 million, compared to Senegal's population of 14 million. [21] [22] Additionally, both countries have high rates of unmet need: 24.5% in Burkina Faso, and 30.1% in Senegal according to 2010 DHS survey data. [23] Average total fertility rates (TFR) have improved slightly in both countries over the last two decades, although Senegal has achieved slightly greater reductions than Burkina Faso. In Senegal, TFR has declined from 6.0 in 1993 to 5.0 in 2010, as compared to a reduction from 6.5 to 6.0 during the same time period in Burkina Faso. [23]

In Senegal, as in many other countries, pills, condoms, and injectables are the most popular modern contraceptive methods among adolescents. In the last few decades, the country has made strides in creating a more family planning-friendly legal and regulatory environment. Despite these changes, many providers will not provide contraception to younger women, especially those under age 18. [24] In addition to a large Muslim majority, Burkina Faso also has large Catholic (19%), and Animist (15.3%) minorities. [22] Contraceptive use is lowest in the predominantly Muslim and Animist regions. The highest rates of modern contraceptive use are in the regions with the two largest urban centers, Hauts-Bassins, and Centre-Nord. The regions in Burkina Faso with the lowest rates of contraceptive use also have the highest child marriage and lowest literacy rates. [25] [26] Among adolescent women, those who are married are less likely to use contraception than those who are unmarried. [25]

Behavior Change Theories and Mass Media

One approach to increasing the use of modern contraception has been the use of mass media campaigns. Mass media campaigns, or behavior change communication (BCC), have been widely used to impact health behaviors. The use of BCC is supported by 2 major theories of behavior change. [27] The first are behavioral prediction theories, which examine why people change their behavior. There are many behavioral prediction theories, however, Salem et. al. assert that overall, there are eight factors which best predict behavior. These include intention, external constraints or barriers, skills, attitude, perceived social pressure, self-image, emotional reaction, and self-efficacy. BCC campaigns are successful because they target their messaging to address these eight factors, or the subset of factors that are barriers to healthy behaviors within the local context. [27] The second set of behavioral theories encompasses behavior change theories, which attempt to explain how individuals change their behavior. One example is the Stages of Change Theory, which theorizes that behavior change is a five step process, with individuals progressing through pre-contemplation, contemplation, preparation, action, and maintenance. Understanding where communities or individuals are in their path to change can help BCC programs adapt their messaging appropriately to reach people at each stage. [27] [28]

Mass Media and Demand Creation

Mass media campaigns have been utilized for decades to promote healthy behaviors, including the use of voluntary family planning. Mass media is often part of larger social marketing campaigns, which might include other demand-generation components such as training of peer educators and community events. Numerous campaigns have demonstrated success in improving family planning knowledge, attitudes, intention, and use. [27] [29] In Uganda for example, Gupta et. al found a statistically significant association between exposure

to BCC, contraceptive use, and intention to use family planning. The study evaluated the Delivery of Improved Services for Health (DISH) project, which included a BCC campaign implemented between 1995 and 1999. As is common among mass media campaigns, DISH utilized multiple media channels, including radio and TV spots, a weekly radio drama, newsletters, pamphlets, and community education activities. The authors' analysis suggested the existence of a dose-response relationship; women who were exposed to FP messaging through multiple forms of media as compared to one message type were more likely to report intention to use modern contraception in the next 12 months (OR=1.49; p-value<.05), and also more likely to report current use of a modern contraceptive method (OR = 1.88; p-value<.0001). Additionally, the study demonstrated that several demographic factors – age, marital status, parity, residence, and educational attainment – were independently associated with modern contraceptive use. [28] Various other studies in several other countries, including, but not limited to, Bangladesh, Nigeria, Nepal, and Tanzania, have demonstrated similar results which support the positive association between exposure to FP mass media campaigns and contraceptive use, intention, and/or knowledge. [30] [31] [32]

Of particular relevance to our study, Babalola and Vonrasek used propensity score matching to evaluate the impact of the Gold Circle (GO) initiative (launched in 1998) on modern contraceptive use among women of reproductive age in Burkina Faso. The GO initiative included both demand and supply side components, with staff training and provision of equipment to clinics on the supply side, and mass media and community activities on the demand side. After adjusting for socio-demographic factors, the authors demonstrated a statistically significant association between a high level of exposure to the mass media campaign (as opposed to zero exposure) and use of a contraceptive method (OR=1.98; 95% CI: 1.19-3.29).

Furthermore, they found a dose-response relationship between level of exposure to the campaign and certain ideation variables that they theorized impact contraceptive use. [33]

Despite the demonstrated success of the mass media campaign, the study was not without its limitations. The data was cross-sectional, so while a statistically significant association was established, conclusions regarding causality are impossible. The issue of non-experimental design, as well as endogeneity, or in this case, the idea that exposure to FP messaging influences contraceptive use, and contraceptive use influences exposure to FP messaging, is cited in several studies as a barrier to evaluating the true impact of mass media campaigns. [28] [30] Different statistical methods – including propensity score matching – have been implemented across various studies which rely on cross-sectional data in an attempt to account for the non-random design, which can make impact evaluation of mass media campaigns difficult. [28] [30] [33] Other studies have utilized quasi-experimental or experimental designs and have still demonstrated an association between mass media exposure and a change in family planning attitudes and behaviors. [31] [32]

In addition to the issue of causality, the GO evaluation results also have limited generalizeability, having focused on women living in two large urban cities, Ouagdougou and Bobo-Dioulasso. This is especially true in a country in which a very large proportion of the population lives in rural areas. Lastly, while the evaluation focused solely on the impact of mass media campaign exposure on contraceptive use, the GO initiative included both supply and demand-side components. Therefore, while the study provides evidence of the effectiveness of mass media campaigns in changing family planning behaviors, it also highlights some of the difficulties in assessing the isolated effects of mass media on family planning use. The factors that lead to contraceptive use are complex; it can be difficult to determine how much of the

increased uptake in modern contraceptive use can be credited to the mass media campaign, as opposed to community outreach, better quality services, and increased access.

Study Rationale

Despite the demonstrated success of mass media campaigns in improving attitudes toward family planning and increasing contraceptive use, there are still gaps that need to be addressed. Few studies have examined mass media campaigns and their impact on adolescents specifically. Fewer still have studied adolescents in West Africa. While it is likely that such campaigns are reaching adolescents, they may not be reaching those who are poorer, rural, and less educated. Furthermore, it is unclear to what extent exposure to family planning messaging is associated with increased contraceptive use among adolescents in West Africa. This study aims to expand the current research base regarding use of, knowledge of, and intention to use family planning among adolescents in West Africa. While propensity score analysis is often used to estimate causal effects using observational data, because we cannot account for potential unmeasured or unknown confounders, we cannot definitively establish causality with our study. However, it will lay the groundwork for future research to further explore the association between exposure to FP messaging and modern contraceptive use. The impact that FP messaging has on contraceptive use is a critical piece of information, which can be utilized by policy-makers and other key decision-markers for planning programs and allocating resources to address the family planning needs of the adolescent population in West Africa. Increasing demand for family planning has the potential to increase contraceptive use, thereby reducing unintended pregnancies and unsafe abortion, improving the health and wellbeing of women and children, as well as provide greater educational, economic, and social opportunities for women.

Study Objectives

The goal of this study was to determine whether FP messaging via mass media campaigns is reaching married adolescent women in Senegal and Burkina Faso, and whether exposure to such messaging is associated with increased modern contraceptive use. We also aimed to understand how exposure to mass media differs according to certain demographic characteristics, such as age, level of education, residence (urban versus rural), and economic status. The very low MCPR among married adolescents in West Africa might make detecting a true association more difficult. Thus we also measured the association between FP messaging exposure and two intermediate outcomes: knowledge of a modern contraceptive method, and intention to use contraception in the future. Since both knowledge and intention are key steps in the pathway to contraceptive use, they were chosen as outcomes to more completely analyze the effectiveness of FP mass media campaigns.

Methods:

DHS Survey Data

We conducted a cross-sectional secondary analysis utilizing data from the Demographic and Health Survey (DHS). DHS is a country-wide survey that samples between 5,000 and 30,000 households and is conducted every 5 years in many developing countries to track progress on a variety of health indicators. [34] Information is available for a wide range of topics, including, but not limited to, family planning knowledge and use. The DHS Program is a project funded by the United States Agency for International Development (USAID) and implemented by ICF International. Because DHS aims to collect data that is comparable across countries, standard model questionnaires have been developed. However, each country can adapt the questionnaire, adding or removing specific questions depending on the relevance to that country. The DHS

survey uses four types of model questionnaires; for the purposes of this study, we utilized data from the 2010 woman's questionnaires from Burkina Faso and Senegal. [35] [36]

The questionnaires for standard DHS surveys have received approval from the ICF International IRB, which ensures protection of human subjects in accordance with US Department of Health and Human Services regulations. Country-specific DHS survey protocols are also reviewed by the ICF IRB. Host country IRBs typically review and approve these protocols as well to ensure compliance with country-specific laws. Prior to each interview, voluntary informed consent is obtained. A parent or guardian provides consent for child or adolescent participants. An informed consent statement is read to participants which includes information regarding the purpose of the interview, expected duration of the interview, interview procedures, potential risks and/or benefits, as well as contact information for a person who can provide the participant with more information about the interview. The consent emphasizes the voluntary and confidential nature of the interview, that the subject may refuse to answer a question, or terminate the interview at any point. Interviews are performed as privately as possible; eligible subjects in a household may not be interviewed in the presence of another eligible subject. Results of the interviews are kept confidential. All DHS data is publically available upon request. [34]

With DHS surveys, the population is often oversampled in less-populous regions to ensure a large enough representative sample. In more populous regions, the population is often under-sampled. The samples are weighted to correct for over-sampling, under-sampling, and different response rates in different regions. After the weights are calculated, they are standardized by dividing each weight by the average of the initial weights. Individual sample weights are standardized separately for men and women so that the total weighted number of

women equals the total un-weighted number of women (and for men as well). To account for the complex survey design, we utilized survey weights in our analysis to produce population estimates.

Statistical Methods

Our original intention was to pool the data from Burkina Faso and Senegal to allow for a larger sample size and broader generalizeability to the region. However, during preliminary analysis it quickly became apparent that pooling was not feasible given the stark dissimilarities between the two countries. Therefore, analysis was conducted separately for each country.

Initial descriptive analysis was performed using a sample of all women of reproductive age (15-49). This included 17,087 women in Burkina Faso, and 15,688 women in Senegal. Exposure to FP messaging via mass media was compared according to various demographic characteristics – age, wealth quintile, level of education, and urban versus rural residence – using the chi square test. All variables were categorical, including age, which was categorized in 5-year age bins. Wealth quintile is a composite index score created by DHS based on several household characteristics, such as ownership of certain commodities, household materials, or the presence of running water or sanitation facilities in the home. [37] In the standard DHS questionnaire, women are asked whether they have been exposed to FP messaging via any of three modalities: radio, TV, newspaper and/or print media. We collapsed FP messaging into a binary variable, where a woman was classified as exposed if she answered "yes" to having heard FP messaging via any of the three forms of media. She was classified as unexposed only if she answered "no" to all three.

Subsequent analysis focused solely on married adolescents (15-19). Currently married women included both married women and those living with a partner. The sample size varied

according to outcome. Since women who were pregnant could not be classified as current users of modern contraception, they were excluded from the analysis in which modern contraceptive use was the outcome. For the outcome "intention to use contraception in the future", women who reported current use of contraception were excluded from the analysis, as they could not be categorized as having a future intention to utilize family planning when they were already doing so. Thus, the sample size for each outcome was different. For modern contraceptive use, the sample size consisted of 767 married adolescent women who were not pregnant at the time of the survey in Burkina Faso, and 822 in Senegal. For the analysis in which knowledge of a modern contraceptive method was the outcome, the sample consisted of all married adolescent women, with 961 women from Burkina Faso, and 996 women from Senegal. For intention, the sample size was 898 from Burkina Faso and 951 from Senegal.

Our preliminary analysis included a crude measure of the association between exposure to FP messaging and modern contraceptive use using univariable logistic regression. This analysis was performed using the sample of unmatched married adolescent women who were not pregnant at the time of the survey (N=767 in Burkina Faso; N=822 in Senegal). While this provided a crude measure of the association of interest, it did not control for important covariates – such as wealth quintile, education, and type of residence – which have been demonstrated to be associated with unmet need. [1] We also ran a multivariable logistic regression model on the unmatched married adolescent sample, with the covariates listed in table 1 included in the model to control for confounding (see table 1). This analysis was conducted to provide an informational comparison with the results from the propensity score model, and thus, full variable selection methods and model diagnostics were not performed. Of note, the covariate for pregnancy was excluded from this initial model, as our sample consisted solely of women who were not

pregnant. However, because this model included a large number of covariates (fifteen), all of which were categorical and many of which included more than two categories, there was the potential for overfitting of the model, utilizing many degrees of freedom. Furthermore, some authors have suggested that traditional covariate adjustment methods may not adequately eliminate bias. [38] We also conducted similar regression analyses for the other two outcomes of interest, knowledge of a modern contraceptive method, and intention to use contraception in the future. In running multivariable logistic regression with the knowledge outcome, some covariates were dropped due to collinearity, or because they were perfect predictors of the outcome. Thus, logistic regression was not the most appropriate analysis if we wanted to retain all of the covariates in the model.

Our subsequent analysis utilized propensity score matching. Doing so allowed for better balancing of the covariates, creating a more similar distribution between exposed and unexposed women. In essence, we were able to use observational data to create more of a randomized design, reducing any systematic differences between exposed and unexposed women, and producing a less biased result. [38] [39] Propensity score matching does have its limitations. While the use of propensity score matching helps account for the non-randomized design of the study, it does not completely obviate the issues associated with reliance on cross-sectional data. [38] [39] The benefits of random allocation to treatment (or in our case, exposure) groups is that it essentially ensures that treatment status is not dependent on baseline characteristics. While propensity score methods attempt to do the same, they cannot control for unmeasured confounders the same way a randomized design can. Despite this, propensity score methods do allow for a significant reduction in confounding and offer an alternative to regression adjustment. [39]

According to Austin, there are four main methods for utilizing propensity scores to estimate the effect of treatment (or exposure) on a particular outcome: propensity score matching, stratification on the propensity score, inverse probability of treatment weighting (IPTW), and adjusting for the propensity score as a covariate in regression analysis. [39] Matching is the most common method of propensity score analysis. There are several forms of matching, however, the most commonly implemented is 1:1 matching, in which one treated (or exposed) subject is matched with one control (or unexposed) subject. [39] We utilized 1:1 matching in our study. In general, matching is best performed on a sample in which there are more subjects in the control group than in the treatment group. [38] Our sample in Senegal met this condition, however, there were more exposed than unexposed women in the Burkina Faso sample. Yet for ease of comparison, we chose to proceed with matching for both countries. We attempted matching both with and without a caliper. However, matching with a caliper resulted in the exclusion of more exposed women than matching without a caliper. We therefore elected to conduct our analysis without a caliper, which may have resulted in less-perfect matches, but allowed for the inclusion of more women.

In stratification, subjects are ordered according to their propensity score and then stratified into groups (commonly quintiles). Stratum-specific treatment effects are then pooled to produce an overall estimate of the treatment effect. IPTW essentially uses the propensity score as a weight, similar to the use of survey weights, which, according to Austin, "creates a synthetic sample in which the distribution of measured baseline covariates is independent of treatment assignment." In the last method, adjusting for the propensity score, the propensity score is included as a covariate in a regression analysis of the association between the exposure and outcome of interest. Stratification, adjustment, and IPTW have the advantage of including all

subjects in the sample, whereas some subjects may be excluded in matching. Propensity score matching, however, has been demonstrated to be better at reducing systematic differences between exposed and unexposed groups according to baseline covariates, as compared to stratification or adjustment with the propensity score. [39] Using IPTW would have been difficult in our study, as we would encounter the complexities of incorporating two weights, given the need to utilize survey weights in our analysis. Therefore, we chose to proceed with matching.

To estimate the propensity scores, we created a multivariable logistic regression model with exposure to FP messaging as a binary outcome. Sixteen categorical covariates were included as variables in the model (see table 1). Women missing data for any of the covariates included in the propensity score model were excluded from the analysis (N=9 for Burkina Faso; N=0 for Senegal). Multilevel variables with small cell counts for certain categories were collapsed to facilitate analysis. For example, very few adolescent women reported greater than two children ever born, so we collapsed the variable into three categories: 0, 1, ≥2 total children ever born. The categories in table 1 reflect how the variables were grouped in the analysis. Predicted probabilities from the multivariable logistic regression model were utilized as the propensity score for each woman. These propensity scores represented a woman's conditional probability of exposure to FP messaging via mass media, regardless of exposure status, based on the 16 covariates included in the propensity score estimation model. Thus, exposed and unexposed women with similar propensity scores had a similar probability of exposure and could be matched accordingly.

Table 1: List of Covariates Included in Propensity Score Model

Covariate	Values
Type of Residence (de facto)	Urban; Rural

|	
Total number of household members[1]	≤ 8; >8
Household wealth quintile (1=poorest)	1; 2; 3; 4; 5
Educational Achievement	No education; incomplete primary; complete primary; incomplete secondary
Partner's Educational Achievement	No education[2]; some education
Household ownership of a radio[3]	No; Yes
Household ownership of a TV[3]	No; Yes
Frequency of reading newspaper or magazine	Not at all; less than once per week; at least once per week
Frequency of listening to radio	Not at all; less than once per week; at least once per week
Frequency of watching TV	Not at all; less than once per week; at least once per week
Total number of children ever born	0; 1; ≥ 2
Age at first birth	No births; ≤15; 15-16; 17-19
Currently pregnant	No or unsure; yes
Currently breastfeeding	No; yes
Visited by an FP worker in the last 12 months	No; yes
Visited a health facility for any reason in the last 12 months	No; yes

[1]Usual residents plus the number of visitors who slept in the house in the previous night
[2]Includes women who did not know their partner's educational status
[3]Based on data from de jure, or usual residents; subjects listed as "not a de jure resident" were categorized as living in a household without a radio or TV

The region of common support, which is used to determine whether there is adequate

overlap in propensity scores between exposed and unexposed groups, thereby allowing for

Chart 1: Region of Common Support; Boxplot of Propensity Score by Exposure Status (0=unexposed; 1=exposed)

Senegal   **Burkina Faso**
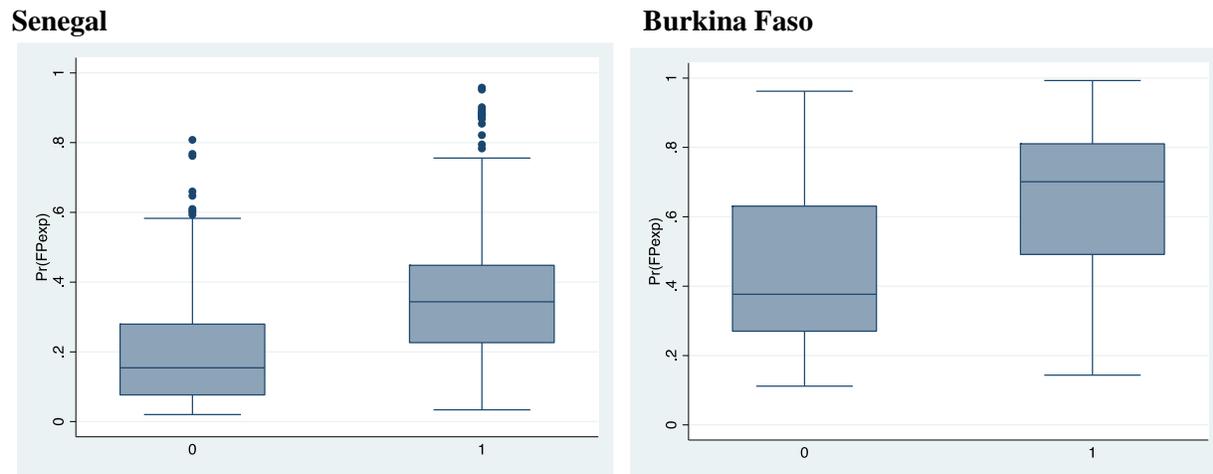
sufficient matches, was evaluated using box plots of the propensity scores according to exposure

(see chart 1). If significant overlap was achieved, the region of common support was determined

to be adequate. Based on visual assessment of the boxplots, there was significant overlap in

propensity scores between exposed and unexposed groups in the Burkina Faso sample. There

was less overlap between the two groups in the Senegal sample, however, we determined that

overlap was sufficient, as the two groups were not entirely disparate. Additionally, as there were

more unexposed than exposed women in the Senegal sample, it was likely that we would be able

to find adequate matches for all of the exposed women.

Once the propensity scores were determined, exposed and unexposed women were

randomly sorted, and matching was conducted using nearest neighbor matching. With nearest

neighbor matching, the first exposed woman was selected and matched with an unexposed

woman with the closest propensity score. We conducted matching without replacement, so both

subjects were removed from the sample before the next match was selected. We utilized the logit of the propensity score for matching, as it generally approximates a normal distribution. [38]

After matching was conducted, balance in the covariates between exposed and unexposed women was assessed using standardized differences (see table 2). Utilizing standardized differences allowed for a comparison of the mean of covariates between exposed and unexposed groups. All of our variables were categorical, thus the standardized difference was calculated as:

$$d = \frac{(Ptreatment - Pcontrol)}{\sqrt{\frac{(Ptreatment\,(1 - Ptreatment) + Pcontrol\,(1 - Pcontrol)}{2}}}$$

where Ptreatment and Pcontrol were the prevalence of the variable among exposed and unexposed groups, respectively. [39] If the standardized differences were low, we concluded that the distribution of the covariates was similar between the two groups, and we had achieved adequate balance. A cutoff of .1, or 10%, was used to determine whether balance had been achieved. While there is no established acceptable threshold for standardized differences in assessing appropriate balance after propensity score matching, this cutoff was chosen based on literature that reported a difference of .1 to be negligible. [39] In an effort to improve balance, several interaction terms were tested, including interactions between wealth quintile and educational attainment, household ownership of radio or TV and frequency of listening to radio or watching TV, wealth quintile and household size, as well as a number of others. If after balancing there were still covariates with a standardized difference of greater than .1, those covariates were included in the final logistic regression model to adjust for any residual imbalance. The final logistic regression model was run on the matched sample using exposure to FP messaging as the primary independent variable, and use of modern contraception, knowledge of a modern method, and intention to use FP in the future, as separate outcomes. All statistical

analysis was performed using Stata 12.1 (copyright StataCorp LP). Levels of significance were

set at an alpha of .05 unless otherwise specified. All proportions and tabulations represent

population level estimates unless otherwise specified.

Table 2: Standardized Differences Between Exposed and Unexposed Women after Propensity Score, Married Adolescent Women, Not Currently Pregnant

Covariate	Burkina Faso[1] (N=355 matched pairs) Standardized Difference	Senegal[2] (N=180 matched pairs) Standardized Difference
Type of Residence (de facto)		
Urban	0.119	-0.06
Rural	-0.119	0.06
Household has a radio[3]		
No	-0.364	0.044
Yes	0.364	-0.044
Household has a TV[3]		
No	-0.122	0.067
Yes	0.122	-0.067
Total Number of Household Members[2]		
≤ 8	-0.049	0.052
>8	0.049	-0.052
Educational Achievement		
No Education	-0.066	-0.011
Incomplete Primary	0.035	-0.078
Complete Primary	-0.023	0
Incomplete Secondary	0.082	0.098
Frequency of Reading Newspaper or Magazine		
Not at all or less than once per week	0.109	0.026
At least once a week	-0.109	-0.026
Frequency of Listening to Radio		
Not at all or less than once per week	-0.68	0.057
At least once a week	0.68	-0.057
Frequency of Watching Television		
Not at all or less than once per week	-0.248	0
At least once a week	0.248	0
Household Wealth Quintile (1 = poorest)		
1	-0.022	0.026

2	-0.213	0
3	0	0.041
4	0.138	-0.087
5	0.141	0.019
Total Number of Children Ever Born		
0	0.046	0.034
1	-0.045	-0.022
≥ 2	0	-0.014
Age at First Birth		
No births	0.006	0.034
< 15 years old	-0.122	0.037
15 – 16 years old	0.043	-0.067
17 – 19 years old	-0.04	0
Visited by FP worker in last 12 months		
No	-0.17	-0.054
Yes	0.17	0.054
Visited a Health Facility for any Reason in last 12 months		
No	-0.16	0.011
Yes	0.16	-0.011
Currently Breastfeeding		
No	0.023	0.067
Yes	-0.023	-0.067
Partner's Educational Achievement		
No Education	-0.103	-0.158
Some Education	0.103	0.158

[1]Data from 2010 Burkina Faso DHS survey
[2]Data from 2010-2011 Senegal DHS survey

Results:

Descriptive Analysis

All women of reproductive age (15-49):

Descriptive analysis of all women of reproductive age focused on exposure to mass media and four demographic characteristics of interest - age, wealth quintile, educational attainment, and type of residence (urban versus rural). In Burkina Faso, eleven women were excluded from the analysis due to missing data. Seven were missing data for educational

attainment. There were sixteen women who were missing data for any one of the exposure variables (radio, TV, or print). However, twelve of the sixteen reported exposure via at least one of the other media modalities, therefore they were classified as "exposed," and included in the analysis. Thus a total of eleven women were excluded, leaving a sample size of 17,076 women of reproductive age. In Senegal, there were no women with missing data for either the exposure variables or the covariates of interest (age, wealth quintile, educational attainment, type of residence), so the entire sample of 15,688 women of reproductive age was used for the initial descriptive analysis.

Overall, a smaller proportion of adolescent women reported exposure to FP messaging as compared to older cohorts (see table 3). This was true regardless of media modality. Adolescent women were less likely to report exposure to FP messaging, whether via radio, TV, or print media, than their older counterparts.

Table 3: Exposure to FP messaging by age group, all women of reproductive age[1,2]

Age Group	Burkina Faso		Senegal	
	Sample N[3]	Exposed (%)	Sample N[3]	Exposed (%)
15-19	3,347	52.97	3,604	31.23
20-24	3,239	62.04	3,169	40.11
25-29	2,940	62.3	2,700	43.41
30-34	2,580	59.56	2,114	43.23
35-39	1,984	56.71	1,788	42.93
40-44	1,660	55.6	1,349	42.05

45-49	1,326	58.9		964	41.93		

In Burkina Faso, a much higher proportion of women reported exposure via radio than TV or print media (see table 4). In contrast, in Senegal, similar proportions of women reported exposure via radio and TV. In both countries, the proportion of women exposed through print media was very small. Again these trends held true across age groups, with lower levels of exposure among adolescent women across all forms of media.

Table 4: Exposure to FP messaging by mode of media, all women of reproductive age[1,2]

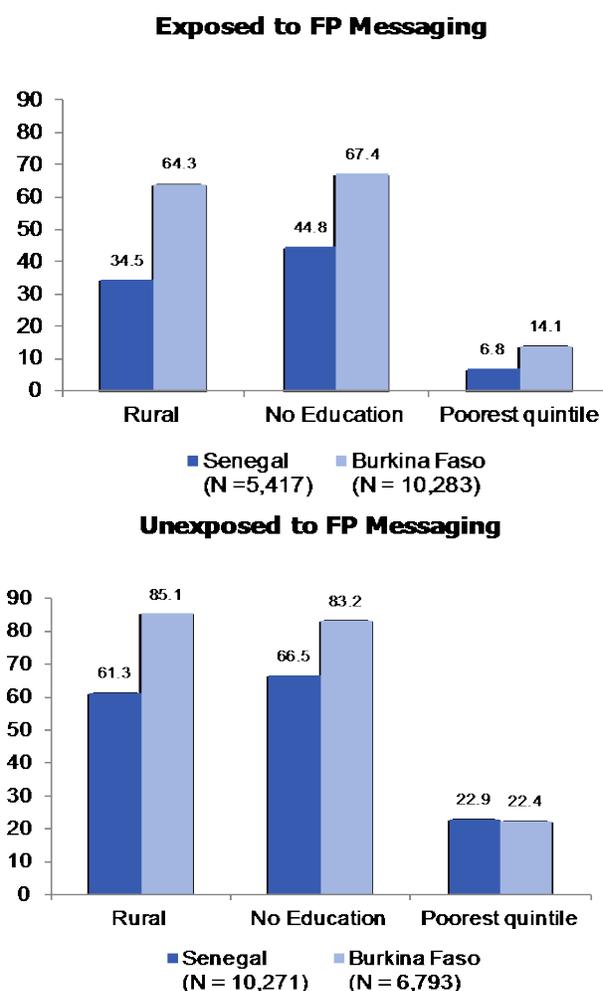| Age Group	Burkina Faso*				Senegal			
	Sample N[3]	Radio (%)	TV (%)	Print (%)	Sample N[3]	Radio (%)	TV (%)	Print (%)
15-19	3,347	44.73	24.71	7.88	3,604	21.14	23.5	4.07
20-24	3,239	56.22	25.32	8.90	3,169	30.04	31.94	4.89
25-29	2,940	59.1	21.19	7.07	2,700	32.12	34.21	5.56
30-34	2,580	57.01	19.77	6.69	2,114	34.14	33.82	5.25
35-39	1,984	55.61	17.26	4.87	1,984	32.91	32.94	5.1
40-44	1,660	54.73	15.99	4.42	1,660	33.25	31.87	6.13
45-49	1,326	54.21	14.37	3.48	1,326	31.26	31.2	4.52

In general, women who reported exposure were more likely to have higher levels of education, be urban, and belong to higher wealth quintiles, than woman who were categorized as unexposed (see chart 2). These trends held true regardless of country. However, there was a significant difference in level of exposure between the two countries, with a greater proportion of women in Burkina Faso (60.2%) reporting exposure to FP messaging via mass media than in Senegal (34.5%). Yet overall, even with the differing levels of exposure, patterns according to background characteristics were similar between the two countries.

Married Adolescent Women

In the married adolescent sample, 9 women

Chart 2: Exposure to Mass Media by Background Characteristics, all women of reproductive age (15-49)

Exposed to FP Messaging

	Senegal (N =5,417)	Burkina Faso (N = 10,283)
Rural	34.5	64.3
No Education	44.8	67.4
Poorest quintile	6.8	14.1

Unexposed to FP Messaging

	Senegal (N = 10,271)	Burkina Faso (N = 6,793)
Rural	61.3	85.1
No Education	66.5	83.2
Poorest quintile	22.9	22.4

Chi-square test, by country: p <.05 for all covariates (type of residence, education status, wealth quintile)

were excluded from the Burkina Faso analysis due to missing data, leaving a sample size of 961. No married adolescent women in the Senegal sample were missing data for any of the covariates of interest (N=996). The majority of married adolescent women in both countries reported that they lived in rural areas (84% in Burkina Faso, 73% in Senegal) (see table 5). There was also a relatively low level of education, with most women reporting that they had no education or had not completed primary school. Approximately 45% of adolescent women in both countries had

not begun childbearing yet. Similar to the larger sample of women of reproductive age, there was a difference in level of exposure according to country, with 55.6% of married adolescent women in Burkina Faso reporting exposure as compared to 23.5% in Senegal. Within both countries, there were statistically significant differences between exposed and unexposed women according to type of residence, wealth quintile, educational achievement, frequency of listening to radio, frequency of watching TV, whether the woman had been visited by an FP worker in the last 12 months, and whether she had visited a health facility in the last 12 months.

In contrast, for several other covariates there were significant differences between the two countries. Importantly, there was a statistically significant association between household ownership of a radio and exposure to FP messaging in Burkina Faso (chi2 test, p-value <.00001), but not in Senegal (chi2 test, p-value = .1692). Additionally, in Senegal, a much larger proportion of adolescent women reported that they lived in extended family units, with greater than eight total household members (75.05% in Senegal, 15.09% in Burkina Faso). Significant differences between the two countries in the strength of the association between covariates and exposure to FP messaging also existed for partner's educational achievement, frequency of reading a newspaper/magazine, total number of children ever born, age at first birth, and whether a woman reported that she was currently breastfeeding. Because of these differences, the data was not pooled and propensity score analysis was conducted separately for the two countries.

Table 5: Background characteristics of married adolescent women (15-19), by country[1]

Covariate	Burkina Faso				Senegal			
	Overall	Unexposed to FP messaging	Exposed to FP messaging	P-value	Overall	Unexposed to FP messaging	Exposed to FP messaging	P-value
	Sample N[2] = 961	Sample N = 426	Sample N = 535	(Chi square)	Sample N[2] = 996	Sample N = 762	Sample N = 234	(Chi square)
	(%)	(%)	(%)		(%)	(%)	(%)	
Type of Residence (de facto)								
Urban	15.58	9.57	20.81	0.0001	26.87	22.59	39.18	0.0041

Rural	84.42	90.43	79.19		73.13	77.41	60.82	
Total Number of Household Members[3]								
≤ 8	84.91	87.18	82.94	0.1189	24.95	25.8	22.49	0.4453
>8	15.09	12.82	17.06		75.05	74.2	77.51	
Household Wealth Quintile (1 = poorest)								
1	19.49	21.15	18.05	<.00001	33.75	39.86	16.17	0.0001
2	24.98	31.15	19.61		24.49	24.49	24.51	
3	21.42	20.04	22.62		14.22	13.11	17.4	
4	19.7	20.02	19.42		17.37	14.45	25.79	
5	14.41	7.65	20.29		10.17	8.09	16.13	
Educational Achievement								
No Education	79.99	85.19	75.46	0.001	69.38	71.8	62.43	0.0075
Incomplete Primary	11.18	10.18	12.04		19.28	18.84	20.52	
Complete Primary	2.45	1.69	3.12		2.4	2.66	1.68	
Incomplete Sec.	6.38	2.93	9.38		8.93	6.7	15.36	
Partner's Educational Achievement								
No Education[4]	77.47	82.66	72.96	0.005	84.32	84.94	82.52	0.503
Some Ed.	22.53	17.34	27.04		15.68	15.06	17.48	
Household has radio[5]								
No	30.07	40.01	21.43	<.00001	23.31	24.93	18.66	0.1692
Yes	69.93	59.99	78.57		76.69	75.07	81.34	
Household has a TV[5]								
No	89.17	94.68	84.38	<.00001	61.18	65.99	47.31	0.0007
Yes	10.83	5.32	15.62		38.82	34.01	52.69	
Freq. of reading newspaper/magazine								
Not at all	95.36	97.98	93.08	0.0016	91.77	92.45	89.79	0.3426
Less than once/wk.	3.15	1.91	4.23		5.93	5.72	6.51	
At least once a wk.	1.48	0.1	2.69		2.31	1.82	3.7	
Freq. of listening to radio								
Not at all	34.46	61.12	11.27	<.00001	17.36	21.39	5.75	<.00001
Less than once/wk.	22.37	15.51	28.33		23.05	27.25	10.98	
At least once a wk.	43.18	23.37	60.4		59.59	51.36	83.27	
Freq. of watching TV								
Not at all	75.74	85.17	67.54	<.00001	40.14	46.24	22.59	<.00001
Less than once/wk.	11.11	8.7	13.21		16.84	17.22	15.74	
At least once a wk.	13.15	6.13	19.26		43.02	36.54	61.67	
Total Number of Children Ever Born								
0	46.52	45.46	47.44	0.5624	45.21	48.43	35.94	0.057

1	45.02	46.86	43.41		38.7	37	43.58	
≥ 2	8.47	7.68	9.14		16.09	14.56	20.48	
Age at First Birth								
No births	46.52	45.46	47.44	0.5342	45.21	48.43	35.94	0.0857
< 15 years old	2.05	2.74	1.44		11.38	11.41	11.28	
15 – 16 years old	17.57	17.01	18.07		21.22	20.51	23.25	
17 – 19 years old	33.86	34.79	33.05		22.19	19.64	29.52	
Currently Pregnant								
No or unsure	80.39	82.73	78.35	0.1315	83.01	82.37	84.84	0.406
Yes	19.61	17.27	21.65		16.99	17.63	15.16	
Currently Breastfeeding								
No	57.27	55.73	58.61	0.4284	60.25	62.67	53.29	0.0902
Yes	42.73	44.27	41.39		39.75	37.33	46.71	
Visited by FP worker in last 12 months								
No	92.41	96.99	88.43	0.0001	96.96	98.98	91.13	<.00001
Yes	7.59	3.01	11.57		3.05	1.02	8.88	
Visited a Health Facility for any Reason in last 12 months								
No	38.91	46.39	32.42	0.0001	45.32	49.49	33.32	0.0018
Yes	61.09	53.61	67.58		54.68	50.51	66.68	

[1]DHS surveys, Burkina Faso 2010; Senegal 2010-2011
[2]N's are sample sizes, not population estimates; survey weights were used to calculate proportions which represent population estimates
[3]Usual residents plus the number of visitors who slept in the house in the previous night
[4]Includes women who did not know their partner's educational status
[5]Based on data from de jure, or usual residents; subjects listed as "not a de jure resident" were categorized as living in a household without a radio or TV

Adjusted and Unadjusted Logistic Regression Analysis

In both countries, the results of the univariable logistic regression analysis demonstrated a very strong positive and statistically significant association between FP messaging exposure and all three outcomes of interest (see table 6). The strongest association was between exposure to FP messaging and knowledge of a modern contraceptive method, with ORs of 20.45 (95% CI: 5.62-74.43) and 10.79 (95% CI: 4.5-25.84) in Burkina Faso and Senegal, respectively. After adjusting for background characteristics, the odds ratios decreased for all three outcomes in both countries. In both Burkina Faso and Senegal, there was still a positive, statistically significant association between FP messaging exposure and knowledge of a modern contraceptive method,

as well as intention to use contraception in the future. However, while there was still a positive association with modern contraceptive use in Senegal (OR=2.27; 95% CI: .92-5.61), the results were no longer statistically significant after adjustment for background characteristics. In Burkina Faso, there was no association between exposure to FP messaging via mass media and modern contraceptive use (OR=.85; 95% CI: .38-1.87).

Table 6: Association between exposure to FP messaging and contraceptive behavior outcomes using univariable and multivariable logistic regression, married adolescent women, unmatched sample[1]

Outcome	Burkina Faso (N=767 for modern cont. use; N =811 for knowledge[2]; N= 898 for intention)		Senegal (N=822 for modern cont. use; N= 974 for knowledge[2]; N = 951 for intention)	
	Crude OR (CI)	Adjusted OR (CI)	Crude OR (CI)	Adjusted OR (CI)
Use of a modern method	2.52 (1.33-4.77)	0.85 (.38-1.87)[3]	3.73 (1.83-7.58)	2.27 (.92 - 5.61)[3]
Knowledge of a modern method	20.45 (5.62-74.43)	15.51 (3.63-66.23)[4]	10.79 (4.5 - 25.84)	6.56 (2.65-16.21)[4]
Intention to use FP in the future	2.25 (1.66 - 3.06)	1.77 (1.23 - 2.53)[4]	2.94 (1.87-4.64)	1.92 (1.11-3.34)[4]

[1]Data from DHS surveys, Burkina Faso 2010; Senegal 2010-2011
[2]N=961 for crude association with knowledge as the outcome in Burkina Faso, N=996 for crude association with knowledge as the outcome in Senegal
[3]Adjusted for type of residence; household ownership of radio and TV; household size; educational achievement; frequency of reading newspaper/magazine; frequency of listening to radio; frequency of watching TV; wealth quintile; total number of births; age at first birth; whether respondent was visited by an FP worker in the last 12 months; whether respondent has visited a health facility in the last 12 months; whether respondent was breastfeeding; partner's educational achievement
[4]Adjusted for all of the above covariates in footnote 1, plus whether or not a respondent was pregnant at the time of the survey

Propensity Score Analysis

Of the 961 married adolescent women in the Burkina Faso sample, nine were excluded due to missing data. The most common missing covariate was "husband's educational achievement" (four women). The number of women included in the matched sample was smaller than that included in the descriptive analysis, as a result of an unequal distribution of

women between exposed and unexposed groups (see table 7). In Burkina Faso, a greater proportion of women reported exposure than were unexposed. Thus, there were 355 matched pairs included in the final analysis of the main outcome, modern contraceptive use, with 57 exposed women excluded. Additionally, these 57 women were "off support," meaning that their propensity scores fell outside of the region of common support. Thus they differed substantially according to their background characteristics compared to the women included in the matched sample. In Senegal, the opposite was true, with only 180 non-pregnant married adolescent women reporting exposure, resulting in 180 matches, with 462 unexposed women excluded. Additionally, 12 of the exposed women in Senegal fell outside of the region of common support and were not included in matching. The number of matched pairs was slightly higher for the analysis with knowledge as the outcome, and slightly lower for intention, for reasons discussed previously.

Table 7: Sample size summary, married adolescent women

Outcome	Burkina Faso			Senegal		
	Overall (N)	Matched Pairs (N)	Unmatched Women[1] (N)	Overall (N)	Matched Pairs (N)	Unmatched Women (N)
Use of a Modern Method	767	355	57	822	180	462
Knowledge of a Modern Method	961	426	109	996	234	528
Intention to use FP in the future	898	406	86	951	197	557

[1]All unmatched women in Burkina Faso were in the exposed category

The unmatched women differed significantly from the matched women according to background characteristics (see table 8). In Burkina Faso, unmatched women were more likely to

be urban, more educated, more frequent radio listeners, and wealthier than matched women. Additionally, a greater proportion had been visited by an FP worker or visited a health clinic in the last 12 months. In Senegal, the situation was reversed, with unmatched women more likely to be rural, less educated, less frequent radio listeners, and poorer than matched women. However, they were more similar to matched women with regards to access variables, with similar proportions in both groups reporting visits by an FP worker or visits to the health clinic in the last 12 months.

Table 8: Background characteristics of matched and unmatched married adolescent non-pregnant women, by country[1]

	Burkina Faso			Senegal		
	Matched		**Unmatched**	**Matched**		**Unmatched**
Covariate	**Unexposed to FP messaging** **N = 355** **(%)**	**Exposed to FP messaging** **N = 355** **(%)**	**N=57** **(%)**	**Unexposed to FP messaging** **N = 180** **(%)**	**Exposed to FP messaging** **N = 180** **(%)**	**N=462** **(%)**
Type of Residence (de facto)						
Urban	15.2	19.7	57.9	28.9	31.7	17.3
Rural	84.8	80.3	42.1	71.1	68.3	82.7
Household has a radio[2]						
No	37.7	21.4	10.5	16.1	17.8	29.7
Yes	62.3	78.6	89.5	83.9	82.2	70.4
Household has a TV[2]						
No	93.2	89.9	57.9	55.6	58.9	79
Yes	6.8	10.1	42.1	44.4	41.1	21
Total Number of Household Members[3]						
≤ 8	86.8	85.1	64.9	23.3	25.6	30.3
>8	13.2	14.9	35.1	76.7	74.4	69.7
Educational Achievement						
No Education	83.4	80.8	36.8	55	54.4	74.9
Incomplete Primary	11.3	12.4	15.8	25.6	22.2	16.5
Complete Primary	1.7	1.4	10.5	1.7	1.7	2.8
Incomplete Secondary	3.7	5.4	36.8	17.8	21.7	5.8
Frequency of Reading Newspaper or Magazine						

Not at all or less than once per week	100	99.4	84.2	95	95.6	99.4
At least once a week	0	0.6	15.8	5	4.4	0.7
Frequency of Listening to Radio						
Not at all or less than once per week	75.8	44.2	3.5	17.2	19.4	62.3
At least once a week	24.2	55.8	96.5	82.8	80.6	37.7
Frequency of Watching Television						
Not at all or less than once per week	93.8	86.5	47.4	50	50	74.7
At least once a week	6.2	13.5	52.6	50	50	25.3
Household Wealth Quintile (1 = poorest)						
1	18.9	18	10.5	22.2	23.3	52.4
2	30.7	21.4	5.3	29.4	29.4	24.9
3	22.5	22.5	8.8	19.4	21.1	11.9
4	18.6	24.2	14	19.4	16.1	8.2
5	9.3	13.8	61.4	9.4	10	2.6
Total Number of Children Ever Born						
0	37.7	40	47.4	37.2	38.9	43.3
1	52.7	50.4	43.9	43.3	42.2	42
≥ 2	9.6	9.6	8.8	19.4	18.9	14.7
Age at First Birth						
No births	37.7	40	47.4	37.2	38.9	43.3
< 15 years old	3.7	1.7	0	9.4	10.6	13
15 – 16 years old	17.7	19.4	19.3	23.9	21.1	21
17 – 19 years old	40.8	38.9	33.3	29.4	29.4	22.7
Visited by FP worker in last 12 months						
No	96.9	93.2	71.9	96.1	95	96.8
Yes	3.1	6.8	28.1	3.9	5	3.3
Visited a Health Facility for any Reason in last 12 months						
No	45.9	38	21.1	44.4	45	55.6
Yes	54.1	62	79	55.6	55	44.4
Currently Breastfeeding						
No	46.2	47.3	50.9	47.2	50.6	56.7
Yes	53.8	52.7	49.1	52.8	49.4	43.3
Partner's Educational Achievement						
No Education[4]	80.6	76.3	36.8	84.4	78.3	86.6
Some Education	19.4	23.7	63.2	15.6	21.7	13.4

[1]Data from DHS surveys, Burkina Faso 2010; Senegal 2010-2011
[2]Based on data from de jure, or usual residents; subjects listed as "not a de jure resident" were categorized as living in a household without a radio or TV
[3]Usual residents plus the number of visitors who slept in the house in the previous night
[4]Includes women who did not know their partner's educational status

After matching, there was still significant imbalance in several of the covariates in the Burkina Faso sample. Several interaction terms were tested; only one (whether a woman reported that she was pregnant at the time of the survey and whether she had visited a health facility in the last 12 months) improved the balance between exposed and unexposed women, as evidenced by smaller standardized differences. This interaction term was included in the initial logistic regression model used to generate the propensity scores in Burkina Faso. Additionally, in Burkina Faso, household ownership of a radio and frequency of listening to the radio were both strongly associated with exposure status. As a result, even after matching based on propensity scores, there was still significant imbalance between exposed and unexposed women with regards to those two covariates. Furthermore, the standardized differences for the variables measuring healthcare access – visited by an FP worker in the last 12 months, and visited a health facility for any reason in the last 12 months – did not meet the cutoff of .1 (see table 2). Therefore, they were included in the final logistic regression model to adjust for any remaining imbalance.

In both countries baseline knowledge level was very high, with at least 85% of women in reporting knowledge of at least one modern contraceptive method regardless of exposure status (see table 9).

Table 9: Summary statistics for contraceptive use and other outcomes by country and exposure status, married adolescent women, matched sample[1]

Outcome	Burkina Faso (N=710 for modern cont. use; N =852 for knowledge; N= 812 for intention)		Senegal (N=360 for modern cont. use; N= 440 for knowledge; N = 394 for intention)	
	Unexposed (%)	Exposed (%)	Unexposed (%)	Exposed (%)
Use of a modern method	4.54	5.91	6.0	13.08

Knowledge of a modern method	88.57	99.21	85.66	97.57
Intention to use FP in the future	63.55	79.08	26.47	38.52

[1]Data from DHS surveys, Burkina Faso 2010; Senegal 2010-2011
[2]Survey weights were used to calculate proportions which represent population estimates

In both countries, there was a very strong and statistically significant association between exposure to FP messaging and knowledge of a modern contraceptive method (OR = 13.66, 95% CI: 3.72 – 50.13 in Burkina Faso; OR = 6.72, 95% CI: 2.55 – 17.65 in Senegal) (see Table 10). While a similar association between exposure and intention was observed in both countries (OR =1.74 for both), the results were not statistically significant in Senegal (p-value = .002 for Burkina Faso; p-value = .086 for Senegal). In terms of modern contraceptive use and exposure to FP messaging, in Senegal there was a positive but not statistically significant association (OR = 2.3; 95% CI: .92 – 5.73). No such association was found in Burkina Faso (OR = .98; 95% CI: .43 – 2.26).

Table 10: Association of exposure to family planning messaging and contraceptive behavior outcomes, matched samples, Burkina Faso and Senegal, 2010[1]

Outcome	Burkina Faso (N=710 for modern cont. use; N =852 for knowledge; N= 812 for intention)		Senegal (N=360 for modern cont. use; N= 440 for knowledge; N = 394 for intention)	
	OR (CI)	P-value	OR (CI)	P-value
Use of a modern method	.98 (.43 – 2.26)[2]	.961	2.3 (.92 – 5.73)[5]	.073
Knowledge of a modern method	13.66 (3.72 – 50.13)[3]	<.0001	6.72 (2.55 – 17.65)	<.0001
Intention to use FP in the future	1.74 (1.22 – 2.49)[4]	.002	1.74 (.92 – 3.28)	.086

[1]Data from DHS surveys, Burkina Faso 2010; Senegal 2010-2011
[2] Adjusted for type of residence; household ownership of a radio; household ownership of a TV; frequency of listening to radio; frequency of watching TV; wealth quintile; whether respondent was visited by an FP worker in the last 12 months; whether respondent has visited a health facility in the last 12 months
[3] Adjusted for household ownership of a radio; frequency of listening to radio; whether respondent has visited a health facility in the last 12 months

Discussion:

Overall our results suggest that in West Africa, FP mass media campaigns are not reaching the most vulnerable groups, such as poorer, less-educated, and more rural women. While our study revealed several important similarities between Burkina Faso and Senegal, the results were also somewhat divergent, highlighting the importance of country context in designing any family planning program, including mass media campaigns. Additionally, while we found an association between exposure to FP messaging and intention to use contraception in the future in both countries, there was a significant gap between intention and use. Understanding this gap and addressing the barriers to use among adolescents is key to increasing contraceptive uptake.

Gaps in Mass Media Exposure

In both countries a larger proportion of women in older cohorts reported exposure than those in younger cohorts. Additionally, exposed women tended to be more urban, wealthier, and more educated than unexposed women. This suggests that mass media campaigns in West Africa are still failing to reach the most vulnerable populations. Indeed, many of the mass media campaigns are outdated, having been designed in the 1980s, and targeted towards more urban, married women. In Senegal, after the 2010 DHS survey results were released, the government included plans for increased investment in mass media in their National Family Planning Action Plan. [40] Additionally, there are current efforts under way to design new campaigns that are more targeted to youth, more rural, and poorer women. [41]

The low level of reported exposure via print media is reflective of the low levels of education among women in both countries. Radio, on the other hand, is fairly ubiquitous in

Burkina Faso, and previous campaigns have successfully relied on radio communication as a means of targeting populations for behavior change. Specifically, Development Media International (DMI) recently conducted a 35-month mass media campaign aimed at changing behaviors related to child mortality in Burkina Faso. Because radio listeners in Burkina Faso often rely on local FM radio, rather than national radio, the authors were able to conduct a cluster randomized control trial. A midline study showed mixed results, with evidence of positive behavior change in some indicators, like care seeking for diarrhea, but no evidence that the campaign had impacted other behaviors. Final results are not yet available, however, the study has promising implications for the use of radio in behavior change campaigns in Burkina Faso. [42] [43] DMI is planning to conduct a similar RCT in Burkina Faso to determine the impact of mass media on modern contraceptive prevalence, with plans for the study to begin this year. [44]

Yet, our results suggest that mass media campaigns that rely on radio, as well as other forms of media, are not as successful at reaching younger women. It may be that newer communication methods are more geared toward reaching young people. Cell phone use is widespread in most developing countries, even in more remote rural areas. Several pilot studies have demonstrated success in using SMS and social media to reach youth in an effort to change health behaviors. In Kenya for example, the Mobile for Reproductive Health (m4RH) program was piloted to provide on-demand information regarding contraception through SMS. Initial results from the pilot study showed that users tended to be younger, with 82% aged 29 and younger. Users also appreciated the ease and confidentiality of the service, and there was some evidence of behavior change with self-reported changes in contraceptive use. [45]

The evidence base for such campaigns is still building, however, and results have not always been positive. In Nigeria, the My Question and Answer (My Q and A) service was

designed to provide confidential information regarding sexual health and HIV/AIDS via SMS. However, a follow-up study showed that despite an increase in use of the service by youth, as well as fairly widespread access to mobile phones, fewer women and girls were utilizing the service than men. Barriers to utilizing the service, as described by women in the study, included poor network quality, socio-cultural factors, lack of confidentiality, reliance on borrowed phones, cost, and a lack of awareness of the service. [46] This suggests that more research is needed to determine the most effective and appropriate means of using mobile technology to reach youth with information regarding family planning. Additionally, it is unclear if the scale-up of projects that rely on newer technology is feasible, cost-effective, or effective in creating long-lasting behavior change. Local context is also important – what works in one country may not necessarily work in another, as is demonstrated by the results of our study. The research to answer such questions is ongoing. Studies like the Adolescent/Youth Reproductive Mobile Access and Delivery Initiative for Love and Life Outcomes (ARMADILLO) are working to develop effective programs for reaching youth with sexual and reproductive health (SRH) information via SMS. By conducting their study in multiple sites, the authors aim to develop a program that is both adaptable to different cultural contexts, as well as scalable. [47] It remains to be seen whether the results of the study will be applicable to youth in West Africa. Further research is needed to determine whether SMS and social media might be effective ways of reaching adolescents in West Africa and increasing modern contraceptive use.

Country Context

While the descriptive statistics demonstrated many similarities between Burkina Faso and Senegal, the significant differences highlight the importance of country context in understanding the barriers and factors that impact use of family planning. Our inability to pool the data from the

two countries due to significant socio-demographic differences further supports the importance of accounting for country context when designing family planning programming. In an ideal world, mass media campaigns would be easily adaptable and translatable from one country to the next. Yet it is clear that such campaigns must be designed carefully and tailored to the local context in order to ensure that they are successful in reaching targeted populations.

Knowledge

In both countries there was a very strong, statistically significant association between exposure to FP messaging and knowledge of a modern contraceptive method. However, the practical relevance of such an association is questionable given the high level of baseline knowledge, even among unexposed women. Knowledge is of course a key step in the pathway to behavior change – women need to be aware of contraception in order to become family planning users. Lack of knowledge has been identified as one of the central causes of unmet need in populations among whom contraceptive use is low, such as adolescents in West Africa. [6] Yet the outcome in our study only measures whether a woman is aware of at least one method of modern contraception. It does not provide more nuanced information, such as whether a woman is aware of multiple methods, is knowledgeable about potential side effects, or has accurate information regarding contraception. Most mass media campaigns provide more detailed information regarding a variety of methods and aim to dispel myths and misconceptions, so it is likely that the strong association between exposure and knowledge is indicative of a higher level of knowledge than just one modern method. But definitive conclusions regarding the amount and type of knowledge gained from exposure cannot be made without further research.

Intention and Modern Contraceptive Use

In both Burkina Faso and Senegal, we found an association between exposure to FP messaging and intention to use contraception in the future. While the association was not statistically significant in Senegal, this may have been the result of the smaller sample size with a much smaller number of exposed women available to participate in matching. Intention is a key step in the pathway to behavior change, and the results suggest that mass media campaigns were effective at changing perspectives around family planning among adolescents. The question is whether intention actually translates into use. In Senegal, there was a positive but statistically insignificant association between exposure and modern contraceptive use, in Burkina Faso, no such association was found. Similar to intention, the lack of statistical significance in Senegal is potentially due to a smaller sample size and inadequate power to detect a statistically significant association. It is worth noting that despite the positive association in Senegal, contraceptive use among exposed and unexposed women was still very low, with only 13% of exposed women using modern contraception. As our study relied on cross-sectional data, the discrepancy between intention and use in Burkina Faso could simply be reflective of a lag between changing attitudes and use. Changes in attitudes usually occur before changes in behavior. [48] Analyzing the same cohort of women once they move past adolescence and into their twenties would likely show higher rates of modern contraceptive use, with a smaller gap between intention and use. It is also highly plausible that the mass media campaigns in Burkina Faso are simply less effective at changing behavior. It could also be that different socio-cultural factors are at play in Burkina Faso than in Senegal. The importance of country context has already been emphasized – it is possible that while adolescent women may intend to use contraception in the future, they may not actually use contraception due to pressure from partners or family to begin or continue childbearing, stigma, or religious considerations. As women age, and move beyond adolescence,

they may have more power to negotiate contraceptive use with partners and family members, especially after they have initiated childbearing. While these same factors likely play a role in Senegal as well, they are complex and the interplay may result in different behaviors in the two countries.

There are other factors worth considering as well. A 1996 study in Morocco by Curtis et al. showed that self-reported intention to use family planning in the future was strongly associated with subsequent use of contraception. The authors utilized longitudinal data from a subpanel of women from the 1992 Morocco DHS, with follow-up in 1995. Among women who reported intention to use FP in 1992, 76% subsequently reported use of a contraceptive method in 1995. This positive association persisted even after controlling for background demographic characteristics. The authors also found that the association between intention and use was far weaker among women living in rural areas than urban areas, and among women who had not given birth in the previous five years. Other factors that contributed to the discrepancy between self-reported intention and subsequent contraceptive use included lack of previous contraceptive use, older age, and a desire for more children. [49] This points to the possibility of supply-side, or access issues. The Curtis study found that urban women who reported intention were more likely to use contraception in the future than rural women. Rural women tend to have less access to health services, including family planning, than urban women. Historically both Burkina Faso and Senegal have had restrictive policies or practices that have disproportionately affected adolescent access to contraception. [41] Additionally there are the barriers of cost, provider stigma, poor quality services, and lack of confidentiality. [14] [15] [16] [17] Adolescents in Senegal may have found ways to circumvent these factors, or may have less difficulty accessing contraception. Senegal recently piloted the Informed Push Model in 2012 to reduce contraceptive

stockouts and increase the reliability of contraceptive supplies. This program has resulted in a

drastically reduced number of stockouts.. [50] The country has also seen a subsequent rise in

modern contraceptive use. [51] While this program was initiated after the 2010 DHS survey data

was collected, its implementation may be reflective of a more supportive policy environment and

greater government commitment. This is not to say that family planning services are easily

accessible to adolescents in Senegal, only that they may have less difficulty accessing

contraception than adolescents in Burkina Faso.

Additional research is needed to examine the effectiveness of the mass media campaigns

in Senegal and Burkina Faso, and to further delineate and understand the differences in the

results between the two countries. More broadly, the evidence base for generating demand in

youth is growing, but needs to be expanded to better understand how to reach such an important

population. The most successful programs have been those that incorporate multiple

interventions, both on the demand and supply side. There have been many pilot studies, but more

research is need to inform scale up and how to increase program effectiveness. [52]

Propensity score analysis versus regression

The results of our multivariable logistic regression model were similar to the results of

our propensity score analysis. Indeed, these two methods of analysis generally result in similar

conclusions [38]. However, propensity score analysis has a number of advantages over

regression adjustment. Propensity score matching allows for the comparison of exposed and

unexposed groups according to the covariates of interest. By assessing balance in the distribution

of covariates between the two groups, we were able to ensure that the comparison we were

making was appropriate. In other words, that the two groups were similar enough to compare,

allowing us to draw valid conclusions from the analysis. Similarly, in regression analysis there

may also be insufficient overlap in the covariate distributions between exposed and unexposed groups. This suggests that comparisons between the two groups may not be appropriate and thus lead to invalid conclusions. However, the distribution of all covariates between groups is not as easily assessed in regression analysis. According to Williamson et al., regression analysis solves the problem of inadequate overlap through extrapolation, which may not be appropriate. [53] By using propensity score analysis, we were able to easily assess the balance in the distribution of covariates between exposed and unexposed women to ensure that we were making a valid comparison. Additionally, propensity score analysis allowed us to include all of the covariates of interest without concern for over-fitting the model. It would have been difficult to fit such a complicated model – one that included 16 multi-level categorical covariates – using logistic regression. [38] Furthermore, it has been suggested that propensity score matching is more robust to model misspecification than regression modeling. [53]

Limitations

The benefit of using propensity score matching was that it allowed us to balance covariates by exposure status and make our comparison groups more similar on key observed confounders that potentially influence not just exposure to FP messaging, but also our outcomes of interest – knowledge, intention, and contraceptive use. At the same time, the analysis only controlled for measured variables. Other factors potentially associated with contraceptive use were not included, such as interaction with family planning providers, myths and misconceptions regarding family planning, influence of family and friends, and importantly, religion and ethnicity. As discussed previously, in Burkina Faso, regions that are predominately Animist or Muslim tend to have lower rates of contraceptive use. [25] Including religion as a covariate in the propensity score model would have allowed for additional control of these potential

confounders. The significant imbalance between exposed and unexposed groups according to certain covariates within the Burkina Faso sample, suggests that there may have been an unidentified and unaccounted for confounder present (such as religion). It is also possible that unknown, unmeasured confounders influenced our results. Further studies will need to be completed to assess the strength of the association between exposure to FP messaging and contraceptive use among adolescents, taking these potential confounders into account.

Moreover, while we utilized propensity score matching to improve the balance of covariates between exposed and unexposed groups, because we relied on nearest neighbor matching without a specified caliper, there was the potential for imperfect matching. By not specifying a caliper, we allowed matches to occur without any restrictions on the maximum allowable difference between the propensity scores of matched subjects. [39] This means that we may have had some matched pairs with very disparate propensity scores. We decided against using a caliper in order to include more women in the matched analysis. While this resulted in increased efficiency, it likely increased our bias, by only partially adjusting for the propensity score. [54] We attempted to control for such bias by comparing the balance of covariates between the two groups using standardized differences. Covariates with standardized differences greater than 10% were included in the final logistic regression model, which allowed us to control for any remaining imbalance. It is also worth noting, that the use of standardized differences to assess balance allowed us to determine whether the general distribution of covariates was similar between exposed and unexposed groups included in the matched pairs, regardless of whether or not a caliper was used.

Additionally, our exposure and outcome data are self-reported and this study is subject the well-known limitations of any retrospective observational study that relies on self-reported

information. However, we utilized a well-known data source, DHS, which is used to generate evidence about fertility worldwide; our results are thus comparable with other studies relying on DHS data. Furthermore, it is possible that women who reported use of contraception, or intention to use family planning in the future, may have had a heightened awareness about family planning and were thus more likely to remember exposure to FP messaging. While our descriptive analysis demonstrated a somewhat direct relationship between age and self-reported exposure to mass media, it is worth noting that a greater proportion of older women (as well as wealthier, more educated, and urban women) use contraception than younger women. Therefore, it is possible that the trends in self-reported exposure were due to reverse causation. Women who are currently using modern contraception may be more likely to recall hearing FP messaging via mass media than those not using a method. Our study is subject to the same issues of endogeneity as previous studies which have attempted to evaluate the impact of mass media campaigns utilizing cross-sectional data, as discussed previously. [28] [30] Future studies will need to be conducted to further explore the association between exposure to FP messaging via mass media and contraceptive use among West African adolescents.

Several women were excluded from matching in both the Burkina Faso and Senegal sample. In Burkina Faso, all of the unmatched women were categorized as exposed to family planning messaging, and tended to be more educated, wealthier, and more likely to live in an urban setting as compared to matched women. In Senegal, opposite patterns were identified, as most of the unmatched women were categorized as unexposed to FP messaging, and were more likely to be less-educated, poorer, and more likely to live in a rural setting as compared to matched women. This makes sense, as our descriptive analysis demonstrated that FP messaging

exposure varied according to type of residence, wealth and educational attainment. However, the exclusion of these women from matching means that overall, our results are less generalizable.

We were unable to measure sexual activity among married and unmarried women. Thus, our results are not generalizable to all adolescent women in Burkina Faso and Senegal, as unmarried sexually active women were excluded from the analysis. Sexual activity is difficult to measure and marriage is thus often used as a proxy. However, especially in urban environments, marriage may no longer be a good proxy for sexual activity among young women. Despite these limitations, our study provides a strong analysis of exposure to FP messaging and contraceptive use among married women in West Africa given the data that is currently available. This information is useful for future research and family planning programming.

Conclusion:

Our study suggests that we are not doing a good job of reaching married adolescent women in West Africa with family planning messaging. Newer technologies may be more geared to reaching adolescents, however, the results thus far have been mixed and additional research is needed to determine whether use of mobile phones and social media for demand-generation is feasible and effective in West Africa. While our study demonstrated a positive association between exposure to FP messaging via mass media and intention to use family planning in the future, additional studies are needed to determine whether the association is causal, as this is an observational study. Furthermore, future studies may be better able to understand the relationship between mass media exposure and contraceptive use among married West African adolescents. Understanding this association is helpful for programmatic planning and resource allocation purposes, programming which will ideally result in increased contraceptive uptake. Increasing voluntary family planning use among adolescents is crucial to

delaying childbearing, reducing fertility rates, and has the potential to improve the health and

economic well-being of women and families.

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