

Unveiling the Effect of Family Planning In Mass Media;

Insights into Supply and Demand Challenges to Unmet Need for Contraception in Ghana

Lovisa Andersson (25571) and Fredrika Danfors (25773)

Abstract: Family planning is recognized as a cornerstone of global development priorities, yet an unmet need for contraception persists in many developing countries, particularly in Sub-Saharan Africa. Further, mass media are commonly utilized to educate the public regarding sexual and reproductive health. Using Ghana's Demographic Health Surveys (2003–2022) this study examines the effectiveness of family planning mass media in raising awareness, improving knowledge, and reducing unmet need for contraception. Additionally, it examines the supply- and demand-side reasons for non-use in Ghana, aiming to inform future family planning media strategies. Our results indicate that exposure to family planning messages significantly increases awareness of contraceptive methods. However, effects on knowledge and unmet need are inconsistent and largely insignificant. Over time, supply-side barriers have declined due to increased awareness, while demand-side barriers, particularly lack of psychosocial access, have risen. Fear of side effects remains a significant obstacle. We advocate future family planning media campaigns to aim at creating positive affective responses to family planning communication and increasing awareness of contraceptive side effects to alleviate fears. Further research is needed to thoroughly assess the interplay between mass media and contraceptive behavior, as well as to evaluate the effectiveness of different content types. We also call for further examination of how the supply- and demand-side reasons to non use move over time, in relation to unmet need.

Keywords: Unmet Need for Contraception, Ghana, Family Planning, Mass Media, Sub-Saharan Africa, Development Economics, Access, Supply and Demand Side Reasons

JEL: E42, E51, O33

Supervisor: Abhijeet Singh

Date Submitted: 2 Dec 2024

Date Examined: 19 Dec 2024

Discussants: Theodor Westerlund Moberg and Flora Öhd

Examiner: Johanna Wallenius

Acknowledgements

We would like to express our deepest gratitude to our supervisor Associate Professor Abhijeet Singh, for his invaluable feedback and support throughout the project. We also wish to extend our sincere gratitude to Professor Magnus Söderlund for generously sharing his expertise in consumer behavior and marketing to significantly enhance the quality of our thesis. Finally, we wish to express our appreciation to our families and friends for their continuous engagement and support.

Thank you,

Fredrika and Lovisa

Contents

1	Introduction	6
2	Ghana Background	7
3	Literature Review	9
3.1	Marketing Concepts	9
3.1.1	Social Marketing	9
3.1.2	Hierarchy of Effects Theory	9
3.2	Conceptual frameworks	9
3.2.1	Westoff’s Supply- and Demand-side Factors to Unmet Need for Contraception . .	10
3.2.2	Choi et al’s Elements of Access	10
3.2.3	Bongaarts’s U-Shaped Curve of Unmet Need of Contraception	10
3.3	Conceptual Foundation for Report	10
3.4	Previous research	12
4	Data	13
4.1	The Ghana Demographic and Health Survey	13
4.2	Data Sub-Selection	13
4.3	Application of Weights	14
5	Descriptive Results	14
5.1	Demographic Trends	14
5.2	Trends within Contraceptive Behavior	16
5.3	Trends Within Family Planning Media	16
5.4	Motivation of Hypothesis	17
6	Methodology	18
6.1	Effect of Family Planning Messages in Mass Media	18
6.1.1	The Ordinary Least Squares (OLS) & Linear Probability Model (LPM)	18
6.1.2	Stepwise Forward Selection Method for Covariates	19
6.1.3	Fixed effects	20
6.1.4	Year Stratified Cross Sectional Analysis and Pooled Model with Time Fixed Effects	20
6.1.5	Cluster Standard Errors	21
6.1.6	Endogeneity Concerns	21

6.1.7	Reverse causality	21
6.1.8	Omitted variable bias	22
6.1.9	Measurement error	22
6.2	Reasons for Non-Use of Contraceptives	23
7	Empirical Results	24
7.1	Effect of Exposure to Family Planning Messages In Mass Media	24
7.1.1	Year Stratified Cross-Sectional Analysis	24
7.1.2	Pooled Model with Time Fixed Effects	27
7.1.3	Robustness and Explanatory Power of Models	28
7.2	Examining Non-Use	29
7.2.1	Time Trends: Reasons for Non-Use Through Elements of Access	29
7.2.2	Time Trends in Supply and Demand, Unmet Need, and Avoiding Pregnancy	30
8	Discussion	31
8.1	Support for Hypothesis	31
8.2	Interpretation of Findings	32
8.3	Implications for Family Planning Messages in Mass Media	33
8.4	Future research	34
9	Conclusion	35
10	References	36
11	Appendix	39

Abbreviations

- **AEO:** African Economic Outlook
- **ARHR:** Alliance for Reproductive Health Rights
- **DHS:** Demographic and Health Survey
- **GNFPP:** Ghana National Family Planning Program
- **GSS:** Ghana Statistical Service
- **GOG:** Government of Ghana
- **LPM:** Linear Probability Model
- **MoH:** Ministry of Health Ghana
- **NHIS:** National Health Insurance Scheme
- **OLS:** Ordinary Least Squares
- **PSU:** Primary Sampling Unit
- **RSE:** Residual Standard Errors
- **TV:** Television
- **WHO:** World Health Organization

1 Introduction

Goldin's groundbreaking research highlighted the transformative role of contraceptives in reshaping economies by unlocking women's full potential in education and the workforce (Goldin, 2020). The availability of modern contraceptives allows women to delay their first pregnancies and achieve their desired family size, resulting in increased years of schooling and workforce participation. According to Goldin, access to contraceptives marks a historic turning point. Effective family planning is further recognized for its potential to mitigate cycles of high fertility, poverty, and economic stagnation in developing countries, making it a cornerstone of global development priorities and initiatives. Moreover, it is regarded as one of the most cost-effective tools for improving human capital and women's socioeconomic status (Jayachandran, 2015).

Despite notable progress in expanding contraceptive access, the unmet need for contraception remains a significant challenge in many developing countries, particularly in Sub-Saharan Africa (UN, 2020). In 2020, approximately 800 women died from preventable causes related to pregnancy and childbirth globally every day, meaning that a woman dies around every two minutes during pregnancy or childbirth (WHO, 2023). Initiatives to encourage family planning and ensure access to contraceptives are widespread, aiming to bridge the gap in unmet needs and foster behavior change. Mass media campaigns are commonly used in developing countries as a cost-effective means of reaching large and diverse audiences, particularly targeting hard-to-reach demographics (Nawas, 1998).

This study focuses on Ghana, a regional leader in fertility transition and the first African nation to recognize high fertility as a barrier to social and economic development (McNamara et al, 1992). Ghana has been a leader in implementing various family planning policies and initiatives over the last decades. As such, the nation provides a compelling case for examining the dynamics of contraceptive behavior and family planning initiatives. Insights from Ghana can offer valuable guidance for family planning interventions and lessons applicable to other nations in Sub-Saharan Africa.

This thesis integrates principles from Social Marketing and Behavioral Change Theories to investigate the role of family planning messages in mass media in addressing Ghana's unmet need for contraception. Thereby, the research questions explored in this report are as follows:

- *Are family planning messages in mass media achieving their current aim of increasing awareness, educating the public, and driving behavior change?*
- *Why are people who want to avoid pregnancy not using contraceptives, even when contraceptive access exists?*
- *How can the findings herein guide future family planning messages in mass media?*

Previous research within Sub-Saharan Africa has predominantly focused on determinants of contraceptive use, identifying factors such as higher educational attainment, household wealth, and urban residency as associated with a higher likelihood of modern contraceptive use. Literature focusing on the reasons for non-use has shown that demand-side reasons constitute a considerably greater proportion of unmet needs than supply-side reasons and that demand-side reasons have grown over time due to attitudinal resistance. Furthermore, health concerns, such as fear of side effects, have been identified as the most prominent reasons for non-use. Research on the effect of family planning messages in mass media has primarily examined contraceptive use within the broader context of socioeconomic determinants, suggesting a positive association between exposure to family planning messages in mass media and contraceptive use.

We expand on existing literature and utilize Ghana Demographic and Health Surveys between 2003-2022 to examine the impact of family planning messages in mass media on aspects of contraception

beyond use and intention, focusing on awareness, knowledge, and unmet need. Raising awareness and knowledge is considered a critical first step in fostering long-term behavior change and a central goal of family planning communication. The focus on unmet needs is motivated by its inclusion in global family planning objectives and its ability to capture the complexities of contraceptive behavior concerning reasons for non-use. The study further delves into the nature of unmet needs in Ghana by examining the factors contributing to non-use. This exploration applies the framework of supply- and demand-side unmet needs, combined with the concept of access, to provide a comprehensive foundation for understanding unmet needs in Ghana.

Our results show that exposure to family planning messages in mass media, particularly via radio, positively and significantly raises awareness of contraceptive methods. There is limited evidence of a positive effect on knowledge and a negative impact on unmet needs, as these findings are inconsistent and largely insignificant. Over the time period, we observe a decline in supply-side reasons and an increase in demand-side reasons for non-use of contraception. The decline in supply-side reasons is primarily driven by improved cognitive access, specifically increased knowledge of contraceptive methods and sources. In contrast, among demand-side reasons, lack of psychosocial access shows an increasing trend, and lack of service quality remains a significant barrier.

We further highlight the importance of family planning communication that underscores the benefits of contraceptive use while addressing barriers to adoption. Based on our findings, addressing demand-side reasons for non-use, particularly lack of psychosocial access and service quality, should be a priority in future family planning policies and communication strategies. Educational content that dispels fears and misinformation about contraceptives, paired with messaging to challenge and reshape social and cultural beliefs, will be essential for addressing the unmet need for contraception in Ghana.

The remainder of this paper is structured as follows: Section 2 provides an overview of family planning initiatives within the Ghanaian context. Section 3 outlines the conceptual framework for our thesis and reviews relevant prior research in the field. Section 4 describes the dataset utilized in our analysis, while Section 5 presents descriptive statistics, highlighting key time trends over the study period, and concludes with our hypothesis. Section 6 delves into the methodology, focusing both on the estimation of the effectiveness of family planning mass media and the exploration of the non-use of contraceptives in Ghana. The results are presented in Section 7 and are further discussed in Section 8, which also addresses the implications for future family planning initiatives and directions for future research. Finally, Section 9 concludes the paper with a summary of our findings.

2 Ghana Background

Ghana is among the leading nations in Sub-Saharan Africa in terms of economic development and growth. Since the 1990s, Ghana has achieved consistent GDP growth and a substantial reduction in poverty rates (AEO, 2024). Notably, Ghana is among the leaders in the decline of fertility rates in Sub-Saharan Africa and was the first African nation to recognize high fertility as an obstacle to social and economic progress (McNamara et al., 1992). The country formulated its official population policy in 1969, followed a year later by the establishment of the Ghana National Family Planning Program (GNFPP).

Numerous policies and plans (shown in Appendices 6 and 7) have been implemented since the population policy, engaging a diverse range of stakeholders. Early efforts focused primarily on improving financial and geographical access to contraceptives and quality reproductive health services. More recent initiatives have sought to address social barriers and dispel misconceptions surrounding contraceptive use to foster demand and uptake.

Through these policies, Ghana has made notable progress in improving financial and geographical access to contraceptives. In terms of financial access, major accomplishments in practice include the National Health Insurance Scheme (NHIS) covering approximately 40% of the population in 2014, and the integration of clinical family planning services into the NHIS in 2022 (ARHR, 2023; Wang et al., 2017). Empirical studies indicate benefits such as increased utilization of healthcare among those covered by the NHIS (Novignon et al., 2021).

Nevertheless, the GNFPP and related policies face criticism for their limited success, characterized by a gap between the written policy and the implementation in practice (MoH, 2015). The Alliance for Reproductive Health Rights reports that Ghana is not on track to meet its family planning objectives for 2020-2025 or 2030. The goal of reducing the unmet need for modern contraceptives from 32% in 2018 to 16% in 2025 remains distant. (ARHR, 2023).

Alongside these policies, various family planning campaigns have been implemented in Ghana during the same period shown in Appendix 7. These campaigns have aimed to educate about sexual health, encourage male participation in family planning discussions, and promote the use and demand for modern contraceptives by addressing social barriers and misconceptions surrounding family planning. The campaigns have been delivered through various channels, including media activities, community outreach programs, and health talks, with some adopting a multi-channel approach. For instance, the Life Choice Campaign, launched in 2010, utilized a range of media, including television (TV), radio, music videos, and newspapers. Within less than a year of its launch, the Ghana Behavior Change Support Project's 2010 baseline survey revealed that 80.7% of men and women recognized the campaign's tagline "It's your life, it's your choice" (Weber et al., 2011). Moreover, the National Family Planning Week in 2022 included TV and radio discussions, health talks with Public Health Specialist Dr. Adu-Gyamfi, and the launch of the TV series *Atoua* on the theme "Breaking the Myths and Misconceptions." In conjunction with the event, Dr. Adu-Gyamfi advocated for continuous family planning education through diverse media platforms, including mass media and social media, to dispel widespread misconceptions and myths about modern contraceptives (ARHR, 2022).

In short, Ghana's efforts in addressing family planning and contraceptive use through media campaigns and policy interventions reflect a great commitment to improving reproductive health. While modern contraceptive use has increased and fertility has declined significantly over the past decades, the remaining unmet need underscores the complexities involved in behavior change.

3 Literature Review

3.1 Marketing Concepts

This section outlines key marketing concepts to illustrate how family planning campaigns have applied them to drive individual behavior change.

3.1.1 Social Marketing

Social marketing, developed by Kotler and Zaltman (1971), applies commercial marketing principles intending to bring about behavioral changes that yield social benefits. Over time, social marketing has gained recognition as a key approach to driving social change by influencing individual behaviors. It has been applied across various fields, including initiatives against smoking, drug misuse, and domestic abuse, as well as promoting HIV/AIDS testing, vaccination uptake, and the prevention of drunk driving. In essence, social marketing involves a program planning process to encourage voluntary behavioral changes in a target audience. The marketer will ask the consumer to perform an action and in exchange, the marketer gives the consumer a benefit, however, the sought action entails costs such as monetary, psychological, or social costs. Bagozzi (1974) means that for an exchange to occur, the perceived benefits must outweigh the associated costs. This is achieved by delivering desired benefits, minimizing internal and external barriers, and leveraging conviction to motivate participation in the sought behavior. Thus, it is essential to understand the determinants of the behavior and the surrounding external structures that enable societal practices, in order to form communication that resonates with the target audience.

3.1.2 Hierarchy of Effects Theory

It is essential to, not only understand the benefits and barriers to contraceptive use but also to assess the effectiveness of family planning messages. Lavidge and Steiner's (1961) research explains that while the effects of campaigns are long-term, measuring the short-term effect is crucial to evaluate the campaign's effectiveness. This helps determine whether the campaign successfully moves consumers through the series of steps that ultimately lead to actual behavior change. The series of steps consists of two cognitive phases: awareness and knowledge; two affective phases: liking and preference; and two conative phases: conviction and behavior. The greater the psychological or economic commitment the behavior entails, the more time and effort it will take to progress through the series of steps. Adopting modern contraceptives is viewed as a significant psychological commitment, particularly in regions where resistance persists due to traditional beliefs and misinformation rooted in cultural, religious, and socio-economic factors. As the cognitive phase of awareness and knowledge is seen as the initial and critical steps for fostering long-term behavior change this highlights the need to evaluate the effect of current family planning communication on such proceeding steps of actual use.

3.2 Conceptual frameworks

In order to understand the mechanisms behind contraceptive behavior, three key frameworks will guide our analysis and form the base for the conceptual foundation of the report.

3.2.1 Westoff's Supply- and Demand-side Factors to Unmet Need for Contraception

The concept of 'unmet need for contraception' was first defined in the late 1970s and has since influenced family planning initiatives worldwide and informed both the Millennium Development Goals and the United Nations' Sustainable Development Goals. Westoff's definition arises through the research of contraceptive behavior using "World Fertility Surveys" (predecessor for Demographic and Health Surveys, DHS) where a "Knowledge, Attitude, Practices (KAP) Gap" was found (Westoff, 1988). The KAP gap refers to a difference regarding knowledge, attitude, and practice, where an individual can have adequate knowledge and a positive attitude, yet not practice contraception. Thus, the KAP Gap in regard to contraceptive use is found in the discrepancy between reproductive preferences and contraceptive practices, indicating an unmet need for contraception. In other words, women reported not explicitly seeking to get pregnant, yet they did not use any contraceptives to prevent pregnancy, where their non-use was attributed to a lack of willingness. As a result, the definition of unmet need expanded to include both women with inadequate access and those unwilling to use contraception, thereby categorizing unmet needs into supply-side and demand-side unmet needs.

3.2.2 Choi et al's Elements of Access

Further understanding access is essential in order to understand the supply- and demand-side reasons for non-use of contraceptives. Access is recognized as a multidimensional concept and has been attempted to be explained by several actors (Penchansky & Thomas, 1981; Bertrand et al., 1995). Most recently Choi et al. (2016) built upon these frameworks and produced a comprehensive definition of access that includes six elements: cognitive accessibility, psychosocial accessibility, geographical accessibility, service quality, administrative accommodation, and affordability. The majority of these elements are, in turn, measured by questions in the DHS, as highlighted by Choi et al. (2016), which we will utilize to further understand the supply- and demand reasons for unmet needs (Figure 3).

3.2.3 Bongaarts's U-Shaped Curve of Unmet Need of Contraception

Bongaarts's (1991) research, using data from Demographic and Health Surveys, examined the progression of unmet need for contraception over time. The study found that unmet need has an inverted U-shape, with the lowest unmet need in regions with either high or low fertility and the highest unmet need in regions with intermediate fertility rates. Unmet needs are relatively small during the early stages of fertility transition due to the low proportion of individuals not wanting pregnancy along with low contraceptive use. As fertility transitions progress, unmet needs increase as the proportion of not wanting pregnancy increases, but the use of contraceptives remains insufficient in narrowing the gap between demand and use. In regions approaching the later stages of the fertility transition, the proportion not wanting pregnancy continues to rise, while the gap declines as more women align their reproductive intentions with the actual use of contraceptives. As Ghana is at the forefront of fertility transition in Sub-Saharan Africa, with a notable decline in fertility rates, this helps explain why Ghana also has a high unmet contraceptive need.

3.3 Conceptual Foundation for Report

Understanding the multidimensional nature of unmet needs is central to this study. Unmet need for contraception refers to the gap between wanting to avoid pregnancy and non-use of contraception. Further, the reasons for non-use are explained through supply- and demand-side reasons. These reasons are in

turn explained through elements of access, namely cognitive accessibility, psychosocial accessibility, geographical accessibility, service quality, administrative accommodation, and financial accessibility. Unmet need also varies across stages of fertility transition. It is low at both high and low fertility rates but peaks at intermediate fertility levels, following Bongaarts' (1991) nonlinear curve. To capture this dynamic, our conceptual framework integrates a time dimension to explore how supply- and demand-side reasons for non-use evolve over time along the unmet need curve. In essence building on Bongaarts's (1991) nonlinear curve of unmet need and Westoff's demand- and supply-side reasons for unmet need simultaneously.

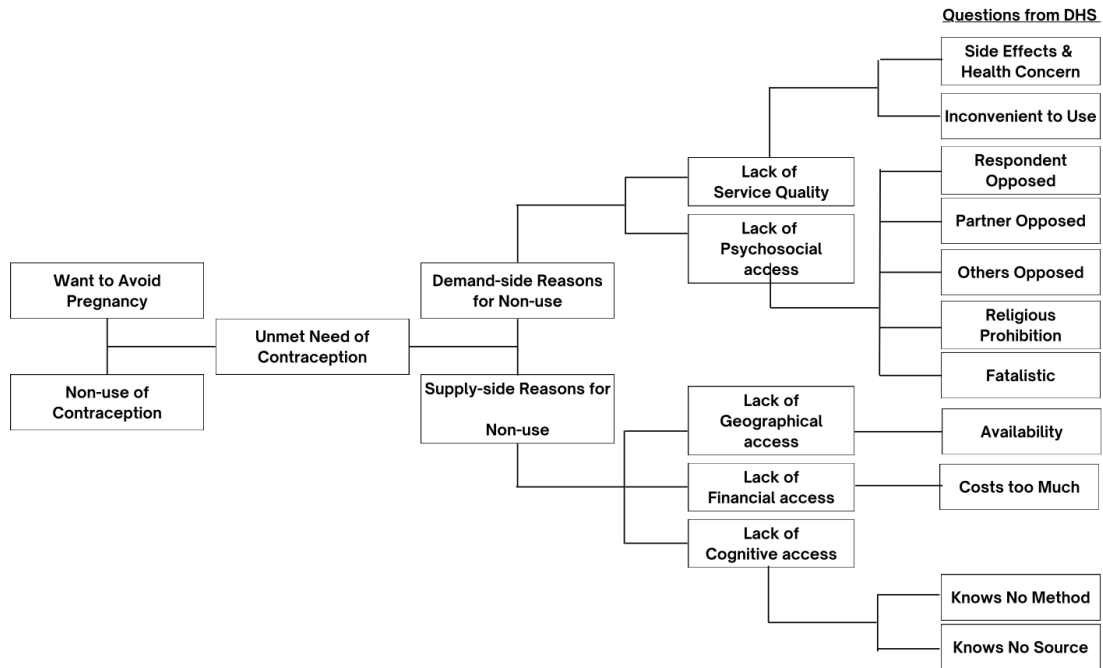


Figure 1: Conceptual Foundation: Authors own illustration

3.4 Previous research

Our literature review is divided into two strands. The first strand examines the literature on determinants of the use and non-use of contraceptives within Sub-Saharan Africa. The second strand examines previous research on the effect of messages in mass media in Ghana.

Previous research examining contraceptive use in Sub-Saharan Africa has mostly examined the determinants of use. Marrone et al. (2014), Nketiah-Amponsah (2012), and Boadu (2022), among others, identified socioeconomic determinants such as higher education attainment, household wealth, and urban residency are associated with a higher likelihood of modern contraceptive use. Sheeran and Taylor (1999) have examined the psychosocial predictors of intentions to use condoms, which in turn predict actual condom use, in comparison to the theories of reasoned action developed by Ajzen and Fishbein and the planned behavior developed by Ajzen. Sheeran and Taylor (1999) found that the perceived barriers, namely condom attractiveness and interpersonal consequences, had a negative correlation with intention to use. Moreover, attitudes toward condoms, subjective norms, descriptive norms, and sexual partner norms affected intentions to use. This body of literature highlights socioeconomic and psychosocial determinants of contraceptive use, providing a foundation that aligns with the theoretical framework explored in our study.

The body of literature examining reasons for the non-use and how they contribute to the unmet need in Sub-Saharan Africa is less comprehensive. Senderowicz and Maloney (2022) utilize the DHS to find that the demand side of unmet needs is considerably higher than the supply side across all seven examined countries in Sub-Saharan Africa. Machiyama and Cleland (2014) examined the reasons for the non-use of modern contraceptives among married women with unmet needs in Ghana from 1998 to 2008. It was found that the supply-side reasons had experienced a decreasing relative contribution to the unmet need, whereas the demand-side reasons had grown through attitudinal resistance. For the supply side, cognitive access is crucial and once knowledge of two specific contraceptive methods and supply source is secured, then geographical access, defined as traveling time or distance, may have little effect on use. Specifically, in 1998 nearly 27% of married women with an unmet need mentioned lack of knowledge as the reason for nonuse compared to 5 % in 2008. At the same time the percentages that mentioned health concerns or fear of side effects as the reason for non-use rose from 14 % in 1988 to 40 % in 2003 and 2008. Moreover, Machiyama and Cleland explored different reasons for non-use in 2008 further by creating four categories of unmet needs defined in terms of access and attitude toward using in the future. Health concerns, encompassing fear of side effects, were found to be the most prominent reasons across all categories. The largest category, at 45%, consisted of women with access and positive attitudes whose main reason for non-use was health concerns at 37% and in which two-thirds of the women had previously used a modern contraceptive method. Interestingly, fear of side effects was as common a reason for women who had never used modern contraceptives. The second largest category of unmet need, at around two-thirds, accounted for women with access but negative attitudes, where the main reasons cited still included health concerns at 53.8% and respondents' opposition at 19%. Thus, the two largest categories of unmet needs in 2008 consisted of categories of women with access.

The literature focusing on the effect of messages in mass media in Ghana has received far less attention. Kansanga et al. (2018) examined the associations between frequent exposure to mass media and National Health Insurance Scheme (NHIS) enrollment in Ghana using data from the 2014 GDHS. A positive and significant relationship was found between being exposed to radio and television at least once a week and enrollment in the NHIS among women. Further, Olaleye and Bankole (1994), utilizing 1988 GDHS data, found a positive influence of exposure to advertisements about specific contraceptive brands in media on current use and intention to use contraceptives among married women in Ghana. Furthermore, they found a positive relationship between positive attitudes, namely women who find it acceptable to provide family planning information on television and radio, and current use and intention to use contraceptives.

The positive attitude was found to have a relatively greater impact on current use than the impact of exposure to media messages. However, studies examining the effect of family planning messages in mass media on contraceptive use in Ghana often do so within a broader context of examining socioeconomic determinants of contraceptive use. For instance, Boadu (2022) and Naidoo et al. (2024) examined various determinants influencing contraceptive use and found a positive effect of exposure to family planning messages in mass media on contraceptive use for both men and women.

A gap in the literature is therefore identified in examining the effect of family planning messages in mass media on dimensions of contraception other than use and intention to use. This study contributes to this strand of literature by examining the effect of family planning messages in mass media on key aspects related to behavior change, namely awareness, knowledge, and unmet needs. Furthermore, the study also contributes to the literature on reasons for non-use, by exploring the supply- and demand-side reasons to unmet need for contraception in Ghana across the period 2003 to 2022.

4 Data

4.1 The Ghana Demographic and Health Survey

This study utilizes Ghana Demographics and Health Surveys (DHS) which are household surveys with the primary objective of providing data for population and health indicators. The information collected is intended to assist policymakers and program managers in designing and evaluating programs and strategies for improving the health of the country's population. The sampling procedure used in the GDHS is stratified two-stage cluster sampling, designed to yield representative results at the national level, for urban and rural areas, and for each of the country's regions (GSS, 2021). Four questionnaires are commonly used in the collection of GDHS: The household questionnaire, the woman's questionnaire, the man's questionnaire, and the biomarker questionnaire. For this analysis, data were extracted from the couple questionnaires that combine the woman's questionnaire and the man's questionnaire from the surveys conducted in 1993, 1998, 2003, 2008, 2014, and 2022.

4.2 Data Sub-Selection

The study is limited to the time period 1993 to 2020 in terms of descriptive statistics and 2003-2022 in terms of empirical results to ensure consistency in the use of the same variables across all years, to allow reliable comparisons, and to minimize variability due to changes in measurement.

Further, the sample used in this study is limited to women of childbearing age, defined as ages 15 to 49 (WHO, n.d.). This corresponds to the sample of women interviewed and identified as household residents or visitors who spent the night prior to the survey in the household. Thus, our sample size in 1998 was 4,834 women, 5,691 in 2003, 4,916 in 2008, 9,396 in 2014, and 15,014 women in 2022. The response rate among women was 97% in 1998, 2008, and 2014, 96% in 2003, and 98% in 2022. This results in a total sample of 38,851 interviewed women.

Some researchers in this field have found it necessary to exclude all non-married women, women who have not yet initiated sex, not menstruated in the last six months, or who are infecund from their sample (Feyisetan & Casterline, 2000). We refrain from the exclusion of women since family planning information, regardless of marital status or current sexual activity, is relevant for all women who have or will have a need to limit or space births and desire to have or share relevant family planning knowledge with others.

4.3 Application of Weights

Solon et al.'s (2015) rationale will be employed in the application of sample weights throughout this study. Due to the specific sample procedure of DHS, and the process of oversampling some regions, unweighted descriptive statistics would not accurately represent the population of women our sample is estimating. Referring to both Solon et al. (2015) and Ghana Statistical Service's (2024) recommendations for applying sample weights, we will therefore be weighting our descriptive statistics to ensure national representativeness. However, we will not be weighting our regression models, as our models aim to estimate relationships between family planning media exposure and outcome variables rather than analyze the socio-economic determinants of the outcome variables. This aligns with statement by Rutstein and Rojas (2003) at DHS, who claim sampling weights are inappropriate for estimating relationships such as regression coefficients. We also followed the recommendations by Solon et al. (2015) to verify our results by performing both weighted and unweighted versions of our regression models and reported both results, shown in Appendices 10, 11, and 12, to ensure that our decision to not apply weights did not lead to significantly different results.

5 Descriptive Results

In this descriptive analysis, we examine trends related mainly to contraceptive behavior and media exposure across different time periods. The tables present a broader picture of the demographic, socio-economic, and cultural change in Ghana. This section ends with the hypothesis of the study.

5.1 Demographic Trends

The demographic trends from 1993 to 2022 shown in Table 1 indicate significant shifts that reflect the broader economic transformations occurring within the country. Urbanization has been a key feature, with the proportion of urban residents increasing from 28.34% in 1993 to 50.98% in 2022. Education levels have seen substantial improvements, particularly for women. The proportion of women with no formal education decreased from 48.08% in 1993 to 25.95% in 2022. Similarly, secondary education among women increased significantly from 5.3% to 50.75% during the same period. Male education levels also rose, but at a slower pace, narrowing the gender education gap but leaving men with slightly higher overall educational attainment. The wealth distribution has experienced more modest trends with a gradual increase in the proportion of individuals belonging to the richer and richest wealth categories, while those in the poorer and poorest categories have declined.

Table 1 also suggests a trend in marriage and childbearing patterns in Ghana. The average age at first child rose from 19.5 in 1993 to 21.2 in 2022, and the average age at first marriage increased similarly. However, the average desired number of children remained fairly unchanged over a time period. In terms of media access, the proportion of individuals with access to a radio in their household increased, peaking at 83.88% in 2008, before declining to 57.52% by 2022. Conversely, television access steadily rose from 18.65% in 1993 to 70.25% in 2022, reflecting notable shifts in media access. Overall, Table 1 highlights significant progress in Ghana in terms of demographic, and socio-economic changes and improvements in gender equality. These shifts provide an important context for understanding the broader changes in family planning and media consumption in Ghana over the time period.

Table 1: Demographic Trends 1993-2022

variable	1993	1998	2003	2008	2014	2022
Urban	28.34	26.39	34.12	41	47.15	50.98
Rural	71.66	73.61	65.88	59	52.85	49.02
Age:15-19	3.66	3.46	3.11	2.47	1.95	1.9
Age:20-24	16.27	17.76	13.73	14.56	12.2	12.15
Age:25-29	24.86	23.94	23.17	21	21.25	19.23
Age:30-34	23.03	19.98	20.04	20.59	20.89	23.24
Age:35-39	13.71	15.01	18.62	19.37	20.69	19.69
Age:40-44	10.97	12.02	12.73	12.18	13.77	14.7
Age:45-49	7.5	7.82	8.59	9.82	9.25	9.1
Female:No education	48.08	40.57	43.04	33.51	29.63	25.95
Female:Primary	45.7	17.8	19.49	21.76	19.52	15.42
Female:Secondary	5.3	39.89	35.54	41.35	45.71	50.75
Female:Higher	0.91	1.73	1.93	3.38	5.13	7.87
Male: No education	34.73	26.44	30.09	23.8	20.12	20.85
Male:Primary	46.62	10.93	11.92	12.02	12.61	12.31
Male:Secondary	13.35	55.15	51.02	54.8	56.38	53.45
Male:Higher	5.3	7.47	6.96	9.39	10.89	13.39
Poorest	Na	Na	24.66	23.03	22.08	21.55
Poorer	Na	Na	20.59	18.78	17.7	18.29
Middle	Na	Na	19.34	15.36	17.6	15.26
Richer	Na	Na	16.48	20.48	18.61	23.58
Richest	Na	Na	18.93	22.34	24.01	21.32
Radio	51.92	67.25	81.51	83.88	75.22	57.52
Television	18.65	27.93	25.8	46.69	64.55	70.25
Age at first marriage	18.6	18.6	18.7	19.2	19.9	20.5
Age at first sex	16.5	17	17.3	17.8	17.5	17.5
Age at first child	19.5	20	19.6	20	20.5	21.2
Ideal number of children	4.9	4.8	5	4.8	4.7	5

Figure 2: Source: GHDS

Table 2: Contraceptive Behavior 1993-2022

	1993	1998	2003	2008	2014	2022
Awareness of Contraceptive Methods	1.34	5.69	7.74	7.11	8.15	8.79
Knowledge About the Ovulatory Cycle	29.72	NA	29.17	36.49	37.57	46.91
Use of Modern Contraceptive	12.8	14.97	20.08	17.38	24.73	29.69
People Wanting to Avoid Pregnancy	53.93	55.04	58.57	57.62	57.73	59.49
Unmet Need	26.02	32.58	33.59	34	30.88	21.06

Figure 3: Source: GHDS

Table 3: Family Planning Media Exposure 1998-2022

	1998	2003	2008	2014	2022
Any family planning media exposure	53.85	79.61	70.21	66.60	57.78
Heard family planning in newspaper	9.53	15.24	8.72	4.35	4.73
Heard family planning on radio	51.26	77.87	65.57	58.53	43.44
Heard family planning on TV	32.11	42.14	40.49	48.45	46.68

Figure 4: Source: GHDS

5.2 Trends within Contraceptive Behavior

Table 2 illustrates key changes in contraceptive behavior in Ghana across our time period. Both awareness and knowledge about the female cycle have improved significantly, with awareness increasing from 1.34% in 1993 to 8.79% in 2022, and knowledge rising from 29.72% in 1993 to 46.91% in 2022, suggesting a positive trend in reproductive health education.

In terms of contraceptive use, we see that the use of modern contraceptives has experienced an increase from 12.8% in 1993 to 29.69% in 2022. We see that the demand for contraceptives (measured as people wanting to avoid pregnancy) has experienced an increase from 53.93% to 59.49%. The unmet need moved from 26.02 % in 1993, reached a peak in 2008 at 34% and experienced a decline to 21.06% in 2022. In other words, between the years 1993-2003, Ghana was experiencing an increase in unmet needs, and a declining trend during the years 2008-2022.

5.3 Trends Within Family Planning Media

Over the past two decades, family planning media exposure in Ghana has exhibited a fluctuating trend, as shown in Table 3. People being exposed to family planning media of any sort has had a declining trend; with a noticeable increase from 79,61% in 2003 to sequentially declining to an average family planning media exposure of 57.78% in 2022. This conflicting average trend can be attributed to shifts in exposure across different media channels. In 2003, nearly 79% of respondents reported exposure to family planning messages through radio in contrast to 43.44% in 2022, marking a significant shift in the consumption of family planning messages. Conversely, exposure to family planning media through television increased from 32.11% in 1998 to 46.68% in 2022. Nevertheless, the rise in television exposure was insufficient to offset the larger decline in radio, leading to an overall decrease in average exposure.

Additionally, the increasing influence of digitalization is evidenced by the 2022 health survey. The survey introduces new questions about mobile phone and smartphone ownership, and internet usage frequency in addition to questions covering new channels for family planning communication. Data reveals that a substantial 81.6% of respondents own a mobile phone, with 45.5% owning smartphones. Furthermore, 10.1% of respondents use the Internet at least once a week, as shown in Appendix 8. This underscores the evolving landscape of channels for family planning messages.

5.4 Motivation of Hypothesis

Figure 2 illustrates key trends in contraceptive behavior and family planning mass media exposure in Ghana over time. It reveals a notable increase in contraceptive awareness and knowledge about the female cycle alongside a shift in the media landscape. In addition unmet needs are beginning to decline with about 20% of women still having an unmet need for contraception. The time trend found in our descriptive statistics forms the basis for the following hypotheses:

- **H1:** Exposure to family planning mass media positively and significantly impacts contraceptive awareness.
- **H2:** Exposure to family planning mass media positively and significantly impacts knowledge about fertility.
- **H3:** Exposure to family planning mass media negatively and significantly impacts the unmet need for contraception.
- **H4:** Supply-side reasons for unmet need have declined over the time period. By the end of the observed period, demand-side factors account for a larger share of the reasons for non-use. Leading to:

$$S(2003) > S(2022)$$

$$S(2022) < D(2022)$$

Where:

$S(2003)$ = Supply-side reasons for non-use in 2003.

$S(2022)$ = Supply-side reasons for non-use in 2022.

$D(2022)$ = Demand-side reasons for non-use in 2022.

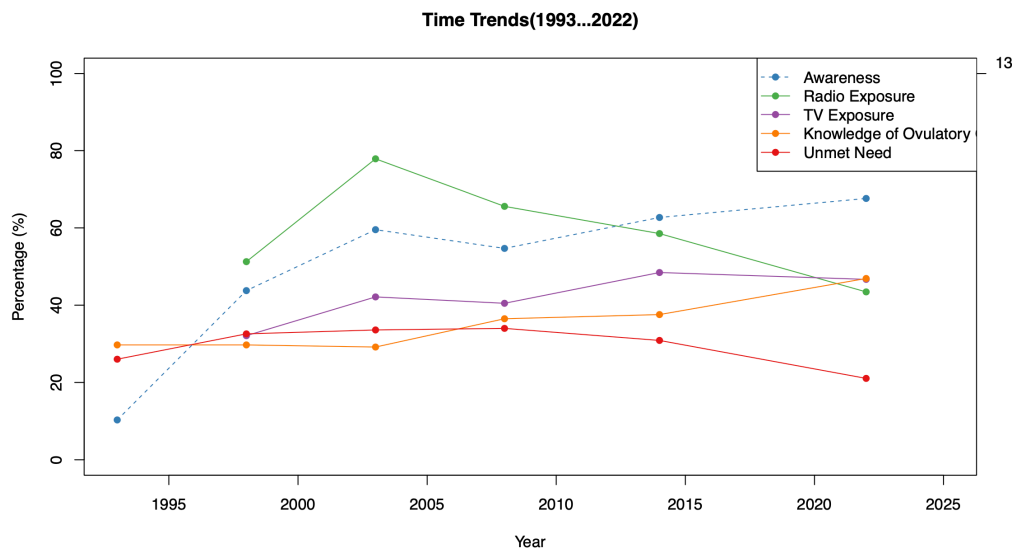


Figure 5: Key Time Trends (1993-2022) Source: GDHS

6 Methodology

Our method is divided into two parts. The first part explains how we estimate how exposure to family planning messages influences awareness, knowledge, and unmet needs across our time period, corresponding to H1, H2, and H3. The second part explains our method for estimating the proportion of unmet needs attributed to supply-side and demand-side reasons for non-use across our time period, corresponding to H4.

6.1 Effect of Family Planning Messages in Mass Media

6.1.1 The Ordinary Least Squares (OLS) & Linear Probability Model (LPM)

To test H1, H2 and H3 and capture the effectiveness of exposure to family planning messages, an Ordinary Least Squares (OLS) model is applied. As knowledge and unmet need for contraception are binary variables in nature, a Linear Probability Model (LPM) is naturally employed. LPM is simply an OLS regression applied to a binary outcome variable. Both models assume linearity, however, in OLS the relationship between the dependent variable and the independent variables is linear in parameters while in LPM the probability of the outcome is modeled as a linear function of the independent variables. This makes the interpretation of the coefficients a bit different. Coefficients in OLS describe the change in the level of the dependent variable for a one-unit change in the independent variable while coefficients in LPM describe the change in the probability of the dependent variable occurring for a one-unit change in the independent variable.

Outcome variables

- **Awareness of contraceptive methods:** Awareness of contraceptive methods is measured as an average score from respondents being presented with a list of 13 contraceptive methods and asked which they are aware of. Each identified method contributes one point to the respondent's total score. Awareness is central to our analysis as it is the first step in the process of adopting family planning methods and ensuring cognitive access to contraceptives.
- **Knowledge about the ovulatory cycle:** Knowledge about the ovulatory cycle is measured as a binary variable, indicating whether the respondent correctly identified the middle of the ovulatory cycle as the most fertile period. This serves as a critical indicator of family planning knowledge, as it directly relates to pregnancy planning and reflects whether the respondent has successfully absorbed key information from family planning messages.
- **Unmet need of contraceptives:** Unmet need for contraception utilized DHS's revised definition, shown in Appendix 21, to ensure alignment with technical experts and ensure consistency to enable reliable tracking over time and across countries (Bradley et al., 2012). The variable consists of married and sexually active unmarried non-users that have an unmet need for spacing or limiting. The definition goes further into subcategorization of the unmet need into group 2 and group 4:
 - Group 2: Pregnant or postpartum amenorrheic women who either did not want the current pregnancy or last birth to occur at all or who would have preferred it to occur at a later time
 - Group 4: Women who are fecund and either do not want any more children, want the next pregnancy to occur in more than two years, or are undecided about whether they want another child

Binary explanatory variables

- Exposure to family planning messages on the radio within the last 12 months
- Exposure to family planning messages on TV within the last 12 months
- Exposure to family planning messages in Newspapers within the last 12 months

We are estimating following relationships

$$\text{Awareness}_{rt} = \beta_0 + \beta_1 \text{Radio}_{rt} + \beta_2 \text{TV}_{rt} + \beta_3 \text{NP}_{rt} + \beta_4 X_{rt} + \delta_r + \epsilon_{rt} \quad (1)$$

$$\text{Knowledge}_{rt} = \beta_0 + \beta_1 \text{Radio}_{rt} + \beta_2 \text{TV}_{rt} + \beta_3 \text{NP}_{rt} + \beta_4 X_{rt} + \delta_r + \epsilon_{rt} \quad (2)$$

$$\text{Unmet Need}_{rt} = \beta_0 + \beta_1 \text{Radio}_{rt} + \beta_2 \text{TV}_{rt} + \beta_3 \text{NP}_{rt} + \beta_4 X_{rt} + \delta_r + \epsilon_{rt} \quad (3)$$

Where:

Awareness_{rt} = Awareness of contraceptive methods in region r , at time t .

Knowledge_{rt} = Knowledge about the ovulatory cycle in region r , at time t .

Unmet need_{rt} = Unmet need of contraception in region r , at time t .

Radio_{rt} = Exposure to family planning messages on the radio within the last 12 months in region r , at time t .

TV_{rt} = Exposure to family planning messages on TV within the last 12 months in region r , at time t .

NP_{rt} = Exposure to family planning messages in newspapers within the last 12 months in region r , at time t .

X_{rt} = Vector of control variables (e.g., age, education, and wealth index).

δ_r = Fixed effects at the region level.

ϵ_{rt} = Capturing unobserved variation in the dependent variable in region r at time t .

6.1.2 Stepwise Forward Selection Method for Covariates

Due to a lack of research on determinants of contraceptive awareness, knowledge about fertility, and unmet need for contraception in Ghana or nearby countries, we can not base our covariates on earlier empirically defined covariates. We have therefore employed a Stepwise Forward Selection method in order to understand what variables explain the largest proportion of variance among our dependent variables. In this way, we aim to control for omitted variable bias in our model. We based the prospect covariates on research that identified determinants of contraceptive use in Ghana and Sub-Saharan Africa, including studies by Marrone et al. (2014), Nketiah-Amponsah (2012), and Boadu (2022).

We implemented The Stepwise Forward Selection Method proposed by Efron (1960) and started with a model solely containing our outcome and explanatory variables and then added covariates one by one and noted the significance and changes in explanatory power. We wanted high explanatory power while still keeping the number of regressors down to avoid overfitting our model. We analyzed our results, as shown in Appendices 17, 18, and 19, and then based our decision of covariates on two criteria:

- **Consistency:** We wanted consistent use of covariates across our models

- **Relevance:** We wanted the covariates to align with the purpose of our research and contribute with information of value for future family planning media

Three main common covariates were found for our three models. Results showed that educational level was the main determinant of most of our outcome variables with a delta-adjusted R squared of 0.083 for the awareness model, and 0.027 for the knowledge model with a significance at a 98 % confidence interval across all models. However, it was not a significant predictor for unmet needs. Age was also consistently and significantly adding explanatory power (Delta adjusted R square of 0.01 for the awareness model, 0.004 for the knowledge model, and 0.01 for the unmet need model) along with wealth index (Delta adjusted R square of 0.002 for the awareness model, 0.01 for knowledge model, 0.02 for unmet need model). Owning a radio and television was excluded from the model, despite consistent significance, to avoid multicollinearity, as such variables are naturally included in the wealth index.

Our final covariates are age, educational level, and wealth index. The age variable is grouped into five-year intervals, covering ages 15 to 49. Educational level is categorized into four levels: No education, Primary education, Secondary education, and Higher education. Lastly, the wealth index estimates socioeconomic status by weighting responses to 33 questions regarding household possessions and characteristics and then dividing the results into the quintiles; poorest, poorer, middle, richer, and richest. In addition, Rutstein and Johnson (2004) show that the wealth index is a better predictor of health outcomes, and contraceptive prevalence in particular, than alternative measurements of economic status such as income- or expeditor-based indexes. This further supports the wealth index as a covariate.

To ensure independence between our explanatory variables and covariates we tested for multicollinearity by employing Variance Inflation Factors (VIF). As all our VIF values are >2 , see Appendix 12, and therefore under the benchmark of <10 (Williams, 2015), we see no signs of multicollinearity.

6.1.3 Fixed effects

We employed a fixed effects model on a regional level to allow control for unobserved heterogeneity that varies across regions but remains constant within a given region during the study period. Our model therefore explores variance within regions. This approach is justified due to the large regional differences in Ghana and as a place of residence has been empirically shown to be a determinant of contraceptive use in Ghana (Boadu, 2022; Aviisah et al., 2018).

6.1.4 Year Stratified Cross Sectional Analysis and Pooled Model with Time Fixed Effects

We both apply a Year Stratified Cross-Sectional Analysis and Pooled Model with Time Fixed Effects. First, we analyze each cross-sectional panel (e.g. 2003, 2008, 2014, and 2022) independently in order to gain insight into how the marginal effects of family planning media exposure might vary by year. Both family planning campaigns can often differ in design and reach across years, along with awareness, knowledge, and unmet needs that can be influenced by shifting policies, campaigns, and societal norms over time. The year-specific approach allows us to capture temporal changes in media exposure and outcomes.

We also employ a Pooled Model with Time Fixed Effects, which assumes that the relationship between media exposure and outcomes remains constant over time. The time fixed effects control for unobserved factors that vary across years but are constant within each year. This provides an aggregated view of the relationship between media exposure and outcomes across the entire time period, working as a good complementary strategy to our year-specific approach. In addition, by pooling the data we aim at increasing

statistical power by leveraging the full dataset, enabling more robust inference about overall trends and relationships.

6.1.5 Cluster Standard Errors

Further, we test for heteroscedasticity in our models, as shown in Appendices 14, 15, and 16, using The Breusch-Pagan Test developed by Breusch and Pagan (1979). Even though our dataset is in a Panel Structure, due to our mostly year-specific approach, where we are treating each cross section independently, not assuming any temporal dependence, the Breusch Pagan test is a suitable approach. The test evaluates the null hypothesis of constant variance in the error term against the alternative hypothesis and reveals clear signs of heteroscedasticity with $p < 0.05$ consistently across all years and models. Thus this violates that our data is identically and independently distributed. To address this issue, we apply clustered standard errors at the primary sampling unit (PSU) level. In DHS surveys, PSUs correspond to enumeration areas (EAs), which are small geographic units designed during national censuses to balance fieldwork feasibility and local variability representation. With approximately 400 EAs per survey, this exceeds the recommended threshold of 50 clusters (Wooldridge, 2010), ensuring robust standard errors and reliable inference. Additionally, clustering at the PSU level aligns with the DHS sampling design, further supporting the validity of our approach.

6.1.6 Endogeneity Concerns

6.1.7 Reverse causality

A key limitation of our model is its lack of experimental design, which precludes establishing the temporal ordering of variables. Specifically, the data does not indicate whether exposure to family planning mass media occurred before changes in respondents' awareness, knowledge, or unmet need for contraception. This limitation raises the possibility of reverse causality, where respondents with higher awareness and knowledge may be more likely to recall exposure to family planning messages. Conversely, people with an unmet need for contraception might be less likely to recall family planning messages. This would bias the estimates of the regression coefficients; Coefficients in the awareness and knowledge models may be overestimated, while coefficients in the unmet need model may be underestimated.

To address this issue, we explored the use of an instrumental variable (IV) approach to test for reverse causality. However, the complexity of working with multiple cross-sectional datasets, combined with the abstract nature of our dependent variables, made identifying a valid instrument challenging. Despite testing several prospect instruments, none fulfilled the dual criteria of relevance and exogeneity, as shown in Appendices 21, 22, 23, and 24. We are therefore relying on empirical findings from related fields. Olaleye and Bankole (1994) examined the possible reverse causality between family planning mass media and contraceptive use by implementing an instrumental variable approach. While being exposed to family planning media has a significant effect on current contraceptive status - the reverse does not seem to be the case. Olaleye and Bankole (1994) thereof claim it is reasonable to treat exposure of media messages as the cause and contraceptive behavior as the effect. In light of this evidence, while the lack of temporal ordering remains a limitation in this study, we proceed under the assumption that family planning media exposure primarily drives the observed changes in awareness, knowledge, and unmet needs due to their close link to contraceptive status.

6.1.8 Omitted variable bias

Omitted variable bias is also recognized as a limitation in our models. There might be unobserved variables that are correlated with both the independent variables and determinants of the dependent variable in our model, which would bias our estimates, causing either an overestimation or underestimation of our coefficients. We account for this through the careful examination of covariates; however, due to limitations in our data, some determinants of our dependent variable that may also be correlated with our media exposure variables, such as shifts in social norms and attitudes, government policies, or family planning initiatives, are not captured. Consequently, this limitation must be kept in mind when interpreting the results.

6.1.9 Measurement error

We also highlight the potential risk of measurement errors in our models. Since the GDHS relies on self-reported data, it is inherently subject to biases, which may cause the observed values in the model to deviate from their true values.

The variables measuring exposure to family planning messages rely on respondents' self-reported answers to whether they have seen or heard such messages in the past 12 months. This introduces potential recall bias, as respondents may struggle to accurately remember past exposures. Additionally, the broad phrasing of the question allows for subjective interpretation, meaning respondents may differ in their understanding of what qualifies as a family planning message. Furthermore, the variable does not differentiate between first-time exposure and repeated exposure, nor does it account for prior exposure outside the specified 12-month period. As a result, respondents categorized as unexposed may have been exposed earlier, complicating the variable's use as a treatment effect. This limitation further suggests that the true "untreated" group in the dataset is likely very small.

In addition, the study also addresses sensitive topics like contraception, influenced by cultural and societal norms, leading to social desirability bias. Respondents may underreport stigmatized reasons for non-use and instead cite neutral factors, leading to endogeneity and bias estimates. Furthermore, the DHS's measure of unmet need includes women who are pregnant or postpartum amenorrheic but wanted their pregnancy later or not at all. This backward-looking definition is subject to post-rationalization bias. Although the DHS data on unmet needs and reasons for contraceptive nonuse are among the most systematically collected and extensively utilized globally, certain data and measurement issues persist. One of the biggest issues related to the binary measure of pregnancy intentions contradicts the growing consensus on the complexity of fertility desires and pregnancy intentions (Senderowicz & Maloney, 2022). Respondents who report being undecided about their pregnancy intentions are categorized alongside women who explicitly state that they do not want another pregnancy, thereby being classified as having an unmet need. Thus, despite the revision in 2012, the measurement still has issues to consider in order to improve the indicator's usefulness for family planning programs.

6.2 Reasons for Non-Use of Contraceptives

To test our hypothesis regarding supply- and demand-side reasons for non-use over time, we rely on the conceptual framework for our report (Figure 1) in the creation of the following equations. Additionally, we use the categorization of reasons for non-use from the DHS, linking them to their associated elements of access (Choi et al., 2016). However, due to a lack of consistency in reporting responses across surveys, we have slightly altered the categorization to ensure compatibility with our dataset, as shown in Appendix 20. All factors represent the percentage proportion of reasons for non-use. Note that the question regarding non-use in the DHS includes additional responses, such as ‘being a faucet’ or ‘not sexually active.’ Since these responses are unrelated to elements of access, they have been excluded from the analysis. Consequently, the total percentage proportion of reasons for non-use in our study is less than 100%. Further we apply weights (as described in Section 5.2) to ensure national representativity. The following equations will be used for our estimations:

Reports DHS Categories	
Reason For Not Using Contraception	Related Element of Access
Knows no method	Cognitive
Knows no source	Cognitive
Respondent opposed	Psychosocial
Husband opposed	Psychosocial
Others opposed	Psychosocial
Religious prohibition	Psychosocial
Fatalistic	Psychosocial
Lack of access	Geographic
Inconvenient to use	Quality
Side effects	Quality
Costs too much	Financial

Figure 6: Reports DHS Categories. Source: GDHS and Choi et al.’s (2016)

$$U(t_i) = D(t_i) + S(t_i)$$

$$D(t_i) = P(t_i) + Q(t_i)$$

$$S(t_i) = C(t_i) + F(t_i) + G(t_i)$$

Where:

t_i = Represents the year (2003, 2008, 2014, 2022).

$D(t_i)$ = The demand-side contribution to non-use.

$S(t_i)$ = The supply-side contribution to non-use.

$P(t_i)$ = Psychosocial barriers.

$Q(t_i)$ = Service quality barriers.

$C(t_i)$ = Cognitive barriers.

$F(t_i)$ = Financial barriers.

$G(t_i)$ = Geographic barriers.

7 Empirical Results

Our empirical results will be divided into two strands; The first strand will estimate the effectiveness of exposure to family planning messages in mass media on our outcome variables while the second section will examine the time trends in supply- and demand-side reasons for non-use of contraceptives.

7.1 Effect of Exposure to Family Planning Messages In Mass Media

When interpreting the coefficients of our models it is important to have the nature of the models in mind. In terms of the awareness model coefficients in the model represent the estimated change in the average awareness score attributed to exposure to family planning messages, holding all other variables in our models constant. When interpreting the results of messages in mass media's effect on knowledge and unmet need, the coefficients correspond to a percentage increase in the probability of having knowledge about the ovulatory cycle and having an unmet need for contraception, holding all other variables in our models constant.

7.1.1 Year Stratified Cross-Sectional Analysis

To start with we find a consistent significant and positive relationship between exposure to family planning mass media and an average higher level of awareness (Table 4). In terms of exposure via radio, coefficients are consistently positive and significant ($p < 0.01$) across all years, indicating that exposure to family planning messages through radio corresponds to an increase in average awareness score. Specifically, exposure to family planning messages through radio corresponds to an approximate 0.102 increase in the average awareness score in 2003, 0.082 in 2008, 0.05 in 2014, and 0.06 in 2022, suggesting a decreasing magnitude of effect over time. The coefficients for television exposure are positive and significant at a 98% confidence level for 2003 and 2022 and at a 90% confidence level for 2008 and 2014. Exposure to family planning messages on television corresponds to an increase in the average awareness score by 0.075 in 2003, declining to 0.032 in 2008, 0.024 in 2014, and 0.046 in 2022. Similar to radio, the magnitude of the effect decreases over time. Regarding family planning messages in newspapers, we find a significant effect corresponding to a higher average awareness at a 90% confidence level in 2003, but no significant effect in the subsequent years. The magnitude of the effect associated with newspapers also diminishes over time.

While the magnitude of the coefficients may appear small it is important to interpret these changes relative to the 0–13 scale of the average awareness score. During the years 2003 to 2022, the average awareness increased from 7.74 to 8.79 methods representing an overall improvement of 1.05 methods over 19 years. This translates to an average annual increase of approximately 0.055 methods per year. The coefficients of the model are comparable to this annual increase, indicating that media exposure plays a significant role in driving awareness improvements. The constant term reflects the yearly baseline awareness score with no media exposure, holding the control variables (wealth, education, and age) constant. We observe an increase in baseline awareness from 0.434 in 2003 to 0.523 in 2022, indicating that baseline awareness has grown over time due to factors unobserved by the model.

Moving on to the impact of family planning messages in mass media via radio, television, and newspapers on knowledge about the ovulatory period in the female cycle we find a less consistent significant and positive relationship (Table 5). The coefficient for exposure to family planning messages on the radio is significant for the years 2008 ($\beta = 0.112$, $p < 0.01$) and 2014 ($\beta = 0.082$, $p < 0.01$). This indicates that respondents with exposure to radio family planning messages had an 11.2% higher probability of having

accurate knowledge about the ovulatory cycle in 2008 and 8.2% in 2014. However, the coefficients for 2003 ($\beta = 0.014$) and 2022 ($\beta = -0.005$) show an insignificant and fluctuating relationship between radio family planning messages and fertility knowledge. Television exposure does not show statistical significance and fluctuates between positive and negative coefficients of small magnitude across the years. Similarly, exposure to family planning messages in newspapers displays both positive and negative coefficients but is only significant at a 90% confidence level in 2014 ($\beta = 0.112$, $p < 0.1$). This rise in the constant term, from 0.153 in 2003 to 0.321 in 2022 ($p < 0.01$), may reflect that the baseline probability of accurate knowledge over time is unrelated to media exposure and covariates have increased. However, in 2008 and 2014, the constant is insignificant and fluctuates between negative and positive ($\beta = -0.060$ in 2008 and $\beta = 0.108$ in 2014). While media exposure, particularly via radio, appears to have contributed to knowledge gains in select years, its overall impact remains inconsistent and can not be confidently determined from this analysis.

Lastly, the impact of family planning messages in mass media via radio, television, and newspapers on the unmet need for contraception also shows less consistent significant relationships (Table 6). The effect of radio exposure is insignificant across all years except for 2014, where radio exposure significantly decreased the probability of unmet need by 5.3% ($p < 0.05$). Television exposure only had a significant effect in 2003, decreasing the unmet need by 5.5% ($p < 0.05$). Newspaper exposure shows insignificant results across all the years. The constant term in this context represents the baseline probability of having an unmet need for contraception unrelated to media exposure and covariates. The constants are consistently significant and relatively high in the earlier years, with values such as 44.7% in 2003, 63.5% in 2008, and 42% in 2014, before declining to 21.1% in 2022. The constant for 2008 is highest (63.5%), aligning with the time trend of unmet needs, as shown in Figure 5. Because the effect of family planning messages in mass media on unmet needs is inconsistent and largely insignificant across years and media channels, its overall impact cannot be confidently determined from this analysis.

Table 4: OLS Regression - Awareness

	<i>Dependent variable:</i>			
	Awareness			
	2003	2008	2014	2022
	(1)	(2)	(3)	(4)
FP Radio	0.102*** (0.014)	0.082*** (0.012)	0.050*** (0.011)	0.060*** (0.008)
FP TV	0.075*** (0.013)	0.032** (0.013)	0.024** (0.012)	0.046*** (0.008)
FP News	0.028* (0.015)	0.034* (0.019)	0.016 (0.020)	0.006 (0.015)
Constant	0.434*** (0.033)	0.246*** (0.041)	0.536*** (0.037)	0.523*** (0.031)
R ²	0.305	0.324	0.240	0.337
Residual Std. Error	0.202 (df = 2112)	0.192 (df = 1863)	0.168 (df = 1802)	0.177 (df = 2867)

Note:

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Clustered standard errors are reported. Region fixed effects and controls (age, education level, wealth) included but not shown.

Figure 7: Source:GHDS

Table 5: OLS Regression - Knowledge About the Ovulatory Cycle

	<i>Dependent variable:</i>			
	Knowledge About the Ovulatory Cycle			
	2003 (1)	2008 (2)	2014 (3)	2022 (4)
FP Radio	0.014 (0.022)	0.112*** (0.023)	0.082*** (0.030)	-0.005 (0.022)
FP TV	0.005 (0.026)	0.024 (0.031)	-0.026 (0.035)	0.002 (0.025)
FP News	0.016 (0.036)	0.036 (0.047)	0.112* (0.064)	-0.010 (0.055)
Constant	0.153*** (0.059)	-0.060 (0.061)	0.108 (0.096)	0.321*** (0.083)
R ²	0.150	0.209	0.042	0.091
Residual Std. Error	0.404 (df = 2112)	0.419 (df = 1863)	0.476 (df = 1802)	0.476 (df = 2867)

Note: * p < 0.1; ** p < 0.05; *** p < 0.01
 Clustered standard errors are reported. Region fixed effects and controls (age, education level, wealth) included but not shown.

Figure 8: Source:GHDS

Table 6: OLS - Unmet Need

	<i>Dependent variable:</i>			
	Unmet Need			
	2003 (1)	2008 (2)	2014 (3)	2022 (4)
FP Radio	0.033 (0.025)	0.028 (0.027)	-0.053** (0.026)	-0.004 (0.018)
FP TV	-0.055** (0.027)	-0.030 (0.033)	0.009 (0.031)	-0.022 (0.019)
FP News	-0.018 (0.026)	-0.008 (0.043)	0.052 (0.057)	-0.038 (0.040)
Constant	0.447*** (0.077)	0.635*** (0.071)	0.420*** (0.083)	0.211*** (0.064)
R ²	0.039	0.030	0.035	0.018
Residual Std. Error	0.463 (df = 2112)	0.468 (df = 1863)	0.449 (df = 1802)	0.408 (df = 2867)

Note: * p < 0.1; ** p < 0.05; *** p < 0.01
 Clustered standard errors are reported. Region fixed effects and controls (age, education level, wealth) included but not shown.

Figure 9: Source:GHDS

7.1.2 Pooled Model with Time Fixed Effects

Table 7: Pooled Regression Models with Time Fixed

	<i>Dependent variable:</i>		
	Awareness Score (1)	Knowledge Cycle (2)	Unmet Need (3)
FP Radio	0.071 ^{***} (0.005)	0.054 ^{***} (0.013)	0.006 (0.012)
FP TV	0.048 ^{***} (0.006)	0.010 (0.014)	-0.032 ^{**} (0.013)
FP News	0.028 ^{***} (0.008)	0.035 (0.024)	-0.023 (0.018)
Constant	0.409 ^{***} (0.019)	0.016 (0.038)	0.456 ^{***} (0.038)
R ²	0.313	0.095	0.031
Residual Std. Error	0.188	0.457	0.445

Note: * p < 0.1; ** p < 0.05; *** p < 0.01

Fixed effects for region, age, and year are included but not shown. Control variables (Wealth, Education) are included but not shown. Clustered standard errors are reported.

Figure 10: Source:GDHS

In contrast to the year-specific models the pooled regression model estimates the relationship between explanatory variables and outcomes across the entire time period (2003–2022) controlling for year-to-year variation across regions (Table 7).

In terms of family planning media exposure's effect on average awareness score, we find consistent positive and significant ($p < 0.01$) results across all media channels. The pooled model confirms the relative magnitude of effects observed in the year-specific models, with radio emerging as the most impactful medium for raising awareness ($\beta = 0.071$), followed by television ($\beta = 0.048$) and newspapers ($\beta = 0.028$). This shows that family planning media exposure, isolating the media exposure effect from year to year changes and looking at the time period as a whole, has had a positive and significant effect on average awareness levels. Regarding family planning media exposure's effect on knowledge about the ovulatory cycle, we find consistent positive and significant ($p < 0.01$) results for exposure through radio. Across our time period exposure to family planning messages through radio corresponds to a 5.4% higher probability of having accurate knowledge about the ovulatory cycle. Lastly, in terms of family planning media exposure's effect on the unmet need for contraception, we find a negative and significant result for exposure through TV ($p < 0.05$). Over the years 2003-2022, exposure to family planning messages through TV corresponds to a 3.2% lower probability of having an unmet need for contraception.

The pooled model controlling for year-to-year variation offers insight into the aggregate effect of media exposure over the entire period. The pooled model displays similar results as our year-specific analysis

but provides more generalized estimates that support some of our results and the fluctuations across years.

7.1.3 Robustness and Explanatory Power of Models

The awareness model demonstrates relatively high explanatory power, with adjusted R^2 values ranging from 24% to 33.7% over the study period. These values suggest that the included predictors explain a substantial portion of the variance in average awareness scores, although unobserved factors contribute to the remaining variance. Additionally, the low residual standard errors (RSE) suggest that the model's predictions are precise relative to the dependent variable's range (1–13).

In contrast, the knowledge and unmet need models exhibit lower explanatory power. The knowledge model's R^2 values range from 15% in 2003, 4.1% in 2014, and 9.1% in 2022, while the unmet need model consistently shows low R^2 values, such as 3.4% in 2014 to 1.8% in 2022. We see similar and slightly stronger R^2 values in the pooled model ($R^2 = 31.13\%$ for awareness, $R^2 = 9.5\%$ for knowledge, and $R^2 = 3.1\%$ for unmet need). Further, the high residual standard errors (RSE) suggest that, on average, the model's predictions deviate from the actual values by approximately 0.45 in terms of both models, which is nearly half of the dependent variable's total possible range (0 to 1). This highlights the model's limited precision. In addition, despite the larger sample size in the pooled model, we do not see much difference regarding RSE.

However, one has to bear in mind that Linear Probability Models typically experience low explanatory power as the model is trying to fit a linear regression line to a binary outcome. These low explanatory variables could also indicate that a significant portion of the variance in the outcomes remains unexplained by our model partly stemming from the nature of the dependent variables. Fertility knowledge is inherently more complex than awareness, requiring not only exposure to information but also cognitive engagement, interpretation, and an understanding of how the information is framed or delivered. This introduces higher variability within the variable, which the model struggles to fully capture. Similarly, unmet need is a multidimensional concept that encompasses a complex behavioral nature. Identifying variables that adequately capture this complexity is challenging, which further contributes to the lower explanatory power of models using such dependent variables.

7.2 Examining Non-Use

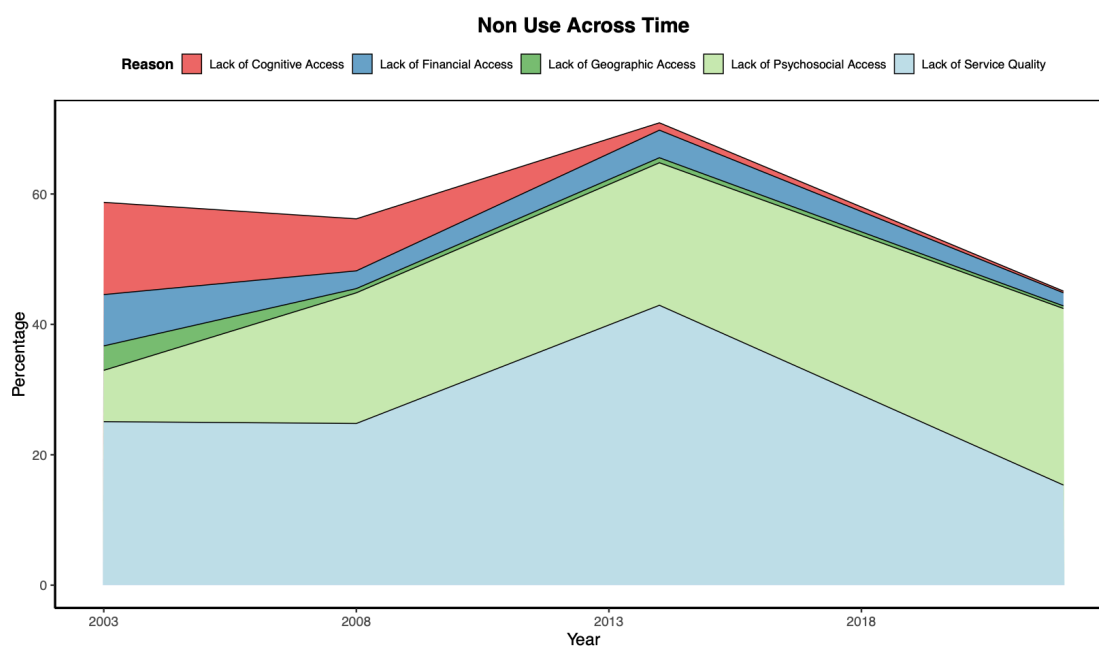


Figure 11: Lack of Access (2003-2022) Source:GDHS

Note: This graph illustrates the proportion of non-use attributed to different dimensions of access, cognitive, financial, geographic, psychosocial, and service quality, over time. Each area represents the contribution of a element of access to the total non-use, highlighting how these dimensions have evolved in their relative importance across the survey years.

7.2.1 Time Trends: Reasons for Non-Use Through Elements of Access

The reasons for the non-use of contraception have varied across the four survey years, reflecting shifts in both demand- and supply-side factors. The total proportion of non-use attributed to lack of access seemed to have peaked in 2014, followed by a decrease in 2022, as seen in Figure 4. The peak was mostly driven by the lack of service quality. Moreover, the total supply- and demand-side reasons for non-use accounted for 58.72 % of non-users in 2003 and 45.1% of non-users in 2022.

Demand-side reasons for non-use, including lack of psychosocial access and service quality, increased from 32.95% in 2003 to a peak of 64.79% in 2014, before decreasing to 42.43% in 2022, as shown in Appendix 22. Overall, this represents an increase over the entire period from 2003 to 2022. In 2003, lack of service quality constituted the largest share of demand-side reasons for non-use. However, by the end of the observed period, the lack of psychosocial access accounted for the largest share of demand-side reasons for non-use. Lack of psychosocial access has increased significantly, from 7.87% in 2003 to 27.08% in 2022, with respondent and husband opposition showing the largest increase within the category, as shown in Appendix 22. By contrast, the lack of service quality declined from 25.08% in 2013 to 15.35% in 2022 and showed a fluctuating trend throughout the time period. Inconvenience to use remained relatively stable

with a slight increase, while the fear of side effects has decreased over the time period, from 23.83% in 2003 to 12.03% in 2022, peaking at 38.39% in 2014.

The supply-side reasons for non-use have decreased, from 25.77% in 2003 to 2.67% in 2022, with the sharpest decline occurring between 2003 and 2008. This decline has been consistent across all individual reasons within the supply-side, with the most substantial decrease seen in the lack of cognitive access, which decreased from 14.15% in 2003 to 0.26% in 2022. The second largest decrease was in the lack of financial access, which decreased from 7.87% in 2003 to 2.01% in 2022. From this, we can conclude that the decline in total supply- and demand-side reasons for non-use is driven by the reduction in the supply-side reasons for non-use.

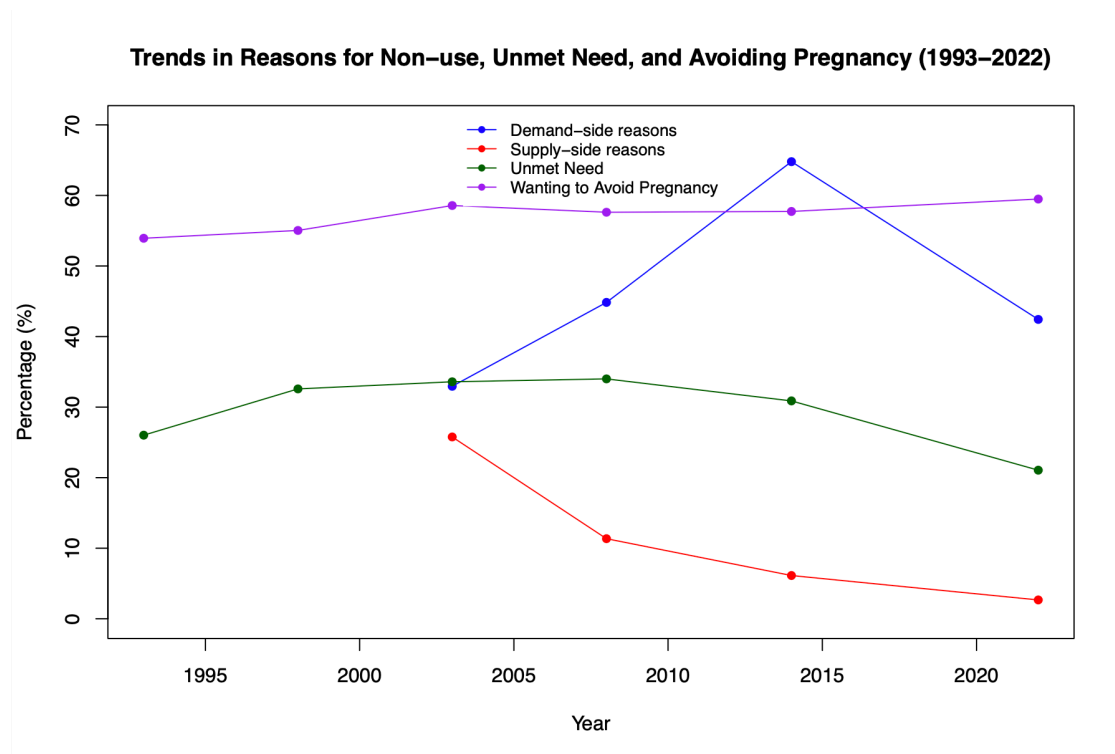


Figure 12: Time Trend Supply and Demand side, Unmet need, Avoiding pregnancy. Source:GDHS

This graph illustrates the time trend of unmet need and among people wanting to avoid pregnancy from 1993-2022. Demand and supply reasons to non-use during 2003-2008 are also illustrated.

7.2.2 Time Trends in Supply and Demand, Unmet Need, and Avoiding Pregnancy

In Figure 5, the supply- and demand-side reasons for non-use from 2003-2022 are plotted alongside the unmet need of contraception and the proportion of women wanting to avoid pregnancy from 1993-2022. As noted before, we observe a declining trend in supply-side reasons for non-use across the time period, while the demand-side reasons have been increasing, reaching their peak in 2014 followed by a decline. The proportion of women wanting to avoid pregnancy remained relatively stable between 2003 and 2022,

with an increase of only 0.92 percentage points (Table 2). This contrasts with the preceding period, from 1993 to 2003, when the proportion increased by 4.64 percentage points. Meanwhile, the unmet need for contraception increased until 2008, reaching a peak at 34%, before declining to 21.06% in 2022. These observed trends in Ghana suggest alignment with Bongaarts' (1991) description of unmet needs following an inverted U-shape (Figure 5).

The trends in Figure 5 suggest some relationships between the observed trends. However, as the proportion of individuals citing the demand- and supply-side reasons does not encompass the entire population of non-users, this limits the ability to suggest causal relationships. Additionally, we note that the unmet need trend may be subject to lagged effects, where a decline in reasons for non-use does not immediately translate into an increase in contraceptive use. The lack of information on the relationship between demand- and supply-side reasons for non-use prior to the time period 2003-2022 represents a constraint in our analysis. This further supports avoiding suggesting causal relationships. Nevertheless, plotting the trends over the time period provides an exploration of how the supply- and demand-side reasons for non-use have developed along the unmet need curve in Ghana.

8 Discussion

8.1 Support for Hypothesis

This section connects our results to the four hypotheses and evaluates their rejection or acceptance.

Based on the results presented in Table 4 and Table 7, we conclude that exposure to family planning mass media, through both radio and TV, has had a positive and significant effect on the average number of contraceptive methods an individual is aware of across the surveyed years from 2003 to 2022. *In other words, our findings support that exposure to family planning mass media has significantly impacted contraceptive awareness, and we therefore accept H1.*

From Table 5, we find a positive and significant effect of exposure to family planning messages through radio on knowledge about the female cycle in 2008 and 2014. However, while the results in Table 5 present a significant relationship between media exposure and knowledge about the female cycle for certain years, no consistent significant effect is observed. In light of the low explanatory power and high RSE, both in the year-specific and pooled regression models, we believe the evidence is too weak to draw broad or definitive conclusions from our findings. *Therefore, we find only partial support that exposure to family planning mass media has significantly impacted knowledge about fertility, leading to a rejection of H2.*

Similarly, the results in Table 6 indicate a significant relationship between media exposure and decreased unmet needs in some years, but no consistent significant effect is observed. We further highlight the low explanatory, and high RSE, in terms of our regression models estimating the effect on unmet needs and are once again cautious in making broad conclusions based on our findings. *Our findings do not consistently support that exposure to family planning mass media has a significant effect on the decline in unmet needs, resulting in a rejection of H3.*

Based on the time trend in Figure 5 and Appendix 22, supply-side reasons for non-use decreased substantially, from 25.77% in 2003 to 2.67% in 2022, whereas demand-side reasons increased from 32.95% in 2003 to 42.43% in 2022, peaking at 64.79% in 2014. Our findings highlight that demand-side reasons for non-use have consistently represented a greater share of the reasons for non-use compared to supply-side reasons over the time period. Additionally, the decreasing trend in supply-side reasons aligns with the findings of Senderowicz and Maloney (2022) for the period 1998-2008. *These results support H4 and as*

$S(2003) = 25.77\% > S(2022) = 2.67\%$, and $D(2022) = 42.43\% > S(2022) = 2.67\%$, we therefore accept $H4$.

8.2 Interpretation of Findings

Table 4 shows a decline in the magnitude of the coefficient for the effect of family planning messages on awareness of contraceptive methods from 2003 to 2022 across all mass media channels. This suggests that while exposure remains significant, its marginal impact on awareness diminishes over time. This diminished effect may reflect several underlying dynamics.

First, Table 4 indicates that the constant awareness has grown over the years, even without exposure to family planning messages in mass media. This growth in baseline awareness may reflect broader societal changes and the impact of family planning initiatives delivered through channels other than mass media, as shown in Appendix 7. An increase in campaigns utilizing non-mass media channels, unobserved by the model, may have contributed to the increase in awareness while simultaneously diluting the unique impact of mass media exposure.

Second, Table 3 indicates a shift in the dominant channel for exposure to family planning messages, from radio to television during the observed time period. However, the effect of radio exposure on awareness remained higher than that of television by the end of the period. Given the evolving media landscape and the inherent differences in how these channels deliver family planning messages, it is plausible that this shift has influenced the marginal impact of each channel on awareness over time.

Lastly, the diminishing effects of media exposure on awareness observed in this study can be understood through the concept of true ceilings (Ettema & Kline, 1977). A true ceiling occurs when a knowledge domain, such as awareness of contraceptive methods, approaches its maximum measurable level, leaving limited room for further gains. This aligns with our finding that awareness scores have increased steadily over time, from 1.34 in 1993 to 8.79 in 2022, nearing the maximum of 13 (Table 2). By 2022, a greater proportion of respondents had reached or approached this true ceiling of awareness, reducing the marginal impact of additional mass media messages. This highlights the natural limitations of cognitive-focused metrics, the effects of knowledge saturations, and helps explain the decline in the positive magnitude of media exposure coefficients. Finally, it would be of interest to analyze the effect of mass media messages on awareness during the period before our study (2003-2022, when average awareness experienced a much steeper increase and the possible true ceiling of awareness was not yet reached).

Moving forward to the time trends in regards to supply- and demand-side reasons for non-use of contraceptives. Within the supply-side reasons for non-use, lack of cognitive access was the second most cited reason for non-use at 14.15% in 2003 but became the least cited reason at 0.26% in 2022, demonstrating substantial improvement in cognitive access to contraceptives. Our regression results suggest that at least part of this improvement can be attributed to family planning messages in mass media, which consistently had a positive and significant effect on awareness of contraceptive methods. A similar trend is evident for geographical access, which moved from being the fifth most commonly cited reason in 2003 to the third least cited reason for non-use in 2022. This improvement in geographical access may be attributed to findings by Machiyama and Cleland (2014), which suggests that once cognitive access is secured, geographical access has less influence on contraceptive use, as well as the implementation of policies in Ghana aimed at enhancing geographical access during this period, shown in Appendices 6 and 7. Furthermore, Machiyama and Cleland (2014) identified health concerns, such as fear of side effects, as the most prominent reason for non-use across all categories, regardless of access or attitudes toward contraception. Similarly, our findings show that fear of side effects accounted for the largest proportion of reasons for non-use over the entire study period and consistently ranked among the top two reasons in each individual year analyzed.

Zan and Rossier (2024) found that higher levels of education and wealth among women influence psychosocial dimensions, such as contraceptive approval, which in turn affects contraceptive use. This suggests that psychosocial access should improve over time, as education levels in particular have increased among women in Ghana (Table 1). However, our findings indicate that this improvement has not yet materialized. Instead, psychosocial reasons for non-use have shown the largest increase among the categories, becoming the most prominent reason for non-use by 2022. The Hierarchy of Effects model suggests that cognitive processes, such as awareness and knowledge, precede affective responses, such as liking and preference. Once cognitive steps are established, the affective steps play a more dominant role, either fostering or preventing behavior. In our context, negative attitudes may have formed, preventing further behavioral changes, as evidenced by the increasing prominence of psychosocial reasons for non-use, such as respondent opposition, after cognitive access was secured. However, the Hierarchy of Effects model suggests that this is not an inevitable outcome. Improved cognitive access to contraceptives does not necessarily lead to heightened psychosocial barriers. Instead, this disconnect may reflect misinformation or ineffective communication strategies that fail to create a positive affective response.

8.3 Implications for Family Planning Messages in Mass Media

Aligning with the concepts of Social Marketing, we emphasize the importance of family planning communication that highlights the benefits of contraceptive use while addressing barriers to adoption. This underscores the importance of family planning initiatives and messages not only continuing to provide access through financial, cognitive, and geographical means but also sustaining and expanding efforts to address psychosocial access and service quality to reduce the unmet need for contraception in Ghana.

First, expanding family planning messages regarding side effects associated with contraceptive use is recommended. Even though we observe a substantial decline in fear of side effects being cited as a reason for non-use, this reason remains the second most prominent reason in 2022. Moreover, the significant effect of family planning messages in mass media on awareness of contraceptive methods suggests that mass media messages could also be effective in disseminating awareness about side effects. Therefore, further emphasis on educational messages on side effects could help address remaining barriers and potentially reduce the unmet need for contraception.

Second, there is a need to enhance or adopt new communication strategies to address social and cultural beliefs regarding contraceptive use. As psychosocial reasons for non-use have increased substantially during the time period and became the most prominent reason in 2022, this suggests that the previous family planning initiatives may not have been effective in addressing psychosocial reasons for non-use. Additionally, the increase of husband opposition, a component within psychosocial reasons for non-use, indicates a growing barrier rooted in partner dynamics. This highlights the need to engage men more actively in family planning communications aiming at altering social norms regarding contraception. Research in the field of Entertainment Education (EE), has emerged with the aim of producing behavior change and shifting social norms. Studies examining the effect of EE initiatives have found significant effects on attitudes and behavior (Banerjee et al., 2019; La Ferrara et al., 2012; Orozco-Olivera, 2023; Berg et al., 2017).

Lastly, an opportunity to leverage the shift in Ghana's media landscape is highlighted. Jensen and Oster (2009) show that television's impact on attitudes and social norms is particularly evident during the early years after its introduction, especially in remote and rural areas where television serves as the primary channel for information about life outside the community. Additionally, Donati et al. (2022) explore the use of social media as a channel for distributing entertainment education, reporting positive results. This indicates an additional opportunity to further utilize emerging digital communication channels in Ghana.

The interactive nature of social media, along with its capacity to foster peer and social support, offers significant potential as a tool for behavior change.

8.4 Future research

Our study raises several important questions for further exploration. Despite our efforts to estimate the effect of family planning messages in mass media on knowledge and unmet needs in Ghana, the results remain uncertain due to inconsistent, and, in most cases, insignificant results across the time period. Investigating the effect of family planning messages on specific reasons for non-use could provide clearer insights into its role in addressing unmet needs. For instance, analyzing the impact of family planning messages on the most commonly cited reason for non-use, lack of psychosocial access, could help guide future initiatives aimed at reducing unmet needs in Ghana. Additionally, a need to adopt complementary questions measuring attitude and opposition clearly is highlighted to enable further exploration of the effect of family planning messages on psychosocial access. Regarding knowledge, future research could expand the scope to include additional dimensions of family planning knowledge beyond the female reproductive cycle. This broader approach could provide a more nuanced understanding of how mass media messages influence family planning knowledge.

The analysis of the decreasing effect of family planning messages on awareness over time highlights an opportunity to further investigate the reasons behind this trend. Examining the impact of family planning messages disseminated through other channels than mass media, such as community campaign events or digital channels, could offer valuable insights into how these efforts complement mass media and what type of outreach is most efficient. Additionally, further studies could employ complementary questions to examine the exposure to specific types of content within media channels, such as TV series, to gain a clearer understanding of the impact of various forms of content.

Lastly, we emphasize the importance of further research into the concept of non-use, as it represents a critical component of the unmet need for contraception. By examining the barriers to use, researchers can gain deeper insights into why unmet need for contraception persists. We encourage future studies to leverage the extensive database provided by the DHS, encompassing decades of research across nearly 90 countries. Building on Bongaarts's (1991) findings regarding the inverted U-shaped curve of unmet need, we further call for an exploration of patterns in how supply- and demand-related reasons for non-use evolve in relation to unmet need. Such research could provide valuable guidance for countries at different stages of fertility transitions and in addressing the unmet need for contraception.

9 Conclusion

In this paper, we explored how family planning messages in mass media, through radio, television, and newspapers, have affected the awareness of contraceptives and knowledge of the ovulatory cycle and the unmet need for contraception in Ghana between 2003 and 2022, as well as exploring how the supply- and demand-side reasons for non-use have evolved over time.

This study contributes by emphasizing the role of mass media in shaping awareness, a crucial first step in fostering behavior change. It also contributes to understanding the complex dynamics surrounding unmet needs, in conjunction with Westoff's (1988) research on the supply and demand side of unmet need for contraception, Bongaarts's (1991) inverted U-shape of unmet need, and analysis of the reasons for non-use using Choi et al.'s (2016) definitions of access. By painting a comprehensive picture of the evolution of unmet needs and reasons for non-use in Ghana between 2003 and 2022 we can provide concrete guidance for future family planning initiatives and media campaigns.

From our regressions, it is observed that exposure to family planning messages, particularly through radio and television, significantly enhances awareness of contraceptive methods. However, the impact on knowledge about the ovulatory and unmet need is less consistent. Additionally, a diminishing effect of awareness over time is observed, which may reflect several underlying dynamics from campaigns utilizing non-mass media channels, an evolving media landscape, and the concept of true ceilings (Ettema and Kline 1977).

Our findings are consistent with Senderowicz and Maloney (2022) as we both find that demand-side reasons for non-use have consistently represented a greater share of the reasons for non-use compared to supply-side reasons over the time period and demand-side reasons have grown through attitudinal resistance such as psychosocial reasons for non-use. Our findings suggest alignment with Machiyama and Cleland's (2014) finding of how when cognitive access is secured, geographical access has a low effect on contraceptive use, further decreasing the supply-side reasons for non-use. Furthermore, our findings align with how Machiyama and Cleland (2014) identified health concerns, such as fear of side effects, as one of the most prominent reasons for non-use. Zhan and Rossier (2024) found higher levels of education to positively influence psychosocial dimensions, such as contraceptive approval, our findings in conjunction with the Hierarchy of Effects model suggesting that this improvement has not yet materialized in Ghana, where we instead found a substantial increase in psychosocial reasons for non-use across the time period. To address the persistent barriers to use we advocate for a need to create positive affective responses to family planning communication to tackle the attitudinal resistance. Moreover, future family planning media campaigns should aim at increasing awareness regarding the side effects of contraceptive use in order to mitigate the prevailing fear of side effects.

Lastly, we further recognized the importance of effective family planning, not only in gender equality but as a cornerstone for global development. The unmet need for contraception remains a pressing challenge, particularly in developing regions such as Sub-Saharan Africa. Therefore, we further emphasize the importance of examining the concept of non-use, as it holds the potential to uncover deeper insights into the persistence of unmet contraceptive needs. While this thesis provides an indication of the relationship between supply- and demand-side reasons for non-use within the context of Ghana, we emphasize the need for further investigation into how these trends interact over time. By doing this in a more generalizable context, it could be of great value to guide countries in their fertility transition stages and in their aim to reduce the unmet need for contraception at different stages. Ultimately, this aligns with the global objective of leveraging family planning as a critical tool for sustainable development.

10 References

- African Development Bank. (2024). African Economic Outlook 2024: Driving Africa's Transformation—The Reform of the Global Financial Architecture. African Development Bank Group https://www.afdb.org/sites/default/files/2024/06/06/aeo_2024_-_country_notes.pdf
- Alliance for Reproductive Health Rights. (2022). Breaking Myths and Misconceptions to Improve Family Planning Uptake; Dr. Yaa Saarah Adu-Gyamfi's Perspective.
- Alliance for Reproductive Health Rights. (2023). The Crucial Role of Family Planning in Advancing Ghana's National Development.
- Aviisah, P. A., Dery, S., Atsu, B. K., Yawson, A., Alotaibi, R. M., Rezk, H. R., & Guure, C. (2018). Modern contraceptive use among women of reproductive age in Ghana: Analysis of the 2003–2014 Ghana Demographic and Health Surveys. *BMC Women's Health*, 18(141). <https://doi.org/10.1186/s12905-018-0634-9>
- Bagozzi, R. P. (1974). Marketing as an Organized Behavioral System of Exchange. *Journal of Marketing*, 38(4), 77–81. <https://doi.org/10.2307/1250397>
- Banerjee, A. V., La Ferrara, E., & Orozco-Olvera, V. (2019) The Entertaining Way to Behavioral Change: Fighting HIV with Mtv (NBER Working Paper No. w26096). National Bureau of Economic Research. <https://ssrn.com/abstract=3423808>
- Berg, G., & Zia, B. (2017). Harnessing Emotional Connections to Improve Financial Decisions: Evaluating the Impact of Financial Education in Mainstream Media. *Journal of the European Economic Association*, 15(5), 1025–1055. <https://www.jstor.org/stable/90023548>
- Bertrand, J. T., Hardee, K., Magnani, R. J., & Angle, M. A. (1995). Access, quality of care, and medical barriers in family planning programs. *International Family Planning Perspectives*, 21(2), 64–74. <https://doi.org/10.2307/2133525>
- Boadu, I. (2022). Coverage and determinants of modern contraceptive use in sub-Saharan Africa: further analysis of demographic and health surveys. *Reproductive Health*, 19, 18. <https://doi.org/10.1186/s12978-022-01332-x>
- Bongaarts, J. (1991). The KAP-Gap and the Unmet Need for Contraception. *Population and Development Review*, 17(2), 293–313. <https://doi.org/10.2307/1973732>
- Bradley, S. E. K., Croft, T. N., Fishel, J. D., & Westoff, C. F. (2012). Revising Unmet Need for Family Planning (DHS Analytical Studies No. 25). ICF International. <https://dhsprogram.com/publications/publication-as25-analytical-studies.cfm>
- Breusch, T. S., & Pagan, A. R. (1979). A simple test for heteroscedasticity and random coefficient variation. *Econometrica*, 47(5), 1287–1294. <https://doi.org/10.2307/1911963>
- Choi, Y., Fabric, M. S., & Adentunji, J. (2016). Measuring Access to Family Planning: Conceptual Frameworks and DHS Data. *Studies in Family Planning*, 47(2), 145–161. <https://pubmed.ncbi.nlm.nih.gov/27285425/>
- Donati, D., Orozco-Olvera, V., & Rao, N. (2022). Using Social Media to Change Gender Norms: An Experiment within Facebook Messenger in India (Policy Research Working Paper No. 10199). World Bank. <https://hdl.handle.net/10986/38113>
- Efroymson, M. A. (1960). Multiple regression analysis. In A. Ralston & H. S. Wilf (Eds.), *Mathematical Methods for Digital Computers* (91–103). Wiley.

- Ettema, J. S., & Kline, F. G. (1977). Deficits, Differences, And Ceiling: Contingent Conditions for Understanding the Knowledge Gap. *Communication Research*, 4(2), 179-202. https://deepblue.lib.umich.edu/bitstream/handle/2027.42/67566/10.1177_009365027700400204.pdf;jsessionid=27F9519EE118EC520FD7465F37F8FEF6?sequence=2
- Feyisetan, B. & Casterline, J. B. (2000). Fertility preferences and contraceptive change in developing countries. *International Family Planning Perspectives*, 26(3), 100-109. <https://doi.org/10.2307/2648298>
- Ghana Statistical Service (GSS), & ICF. (2021). Ghana Demographic and Health Survey 2021: Key indicators report (DHS Program publication PR149). GSS and ICF. <https://dhsprogram.com/pubs/pdf/PR149/PR149.pdf>
- Goldin, C., & Katz, L.F. (2002). The power of the pill: Oral contraceptives and women's career and marriage decisions. *Journal of Political Economy*, 110(4), 730-770.
- Government of Ghana (2015). Ghana Family Planning Costed Implementation Plan 2016-2020. https://www.healthpolicyproject.com/ns/docs/Ghana_FP_CIP_9_28.pdf
- Jayachandran, S. (2015). The roots of gender inequality in developing countries. *The Annual Review of Economics*, 7, 63-88. <https://doi.org/10.1146/annurev-economics-080614-115404>
- Jensen, R., & Oster, E. (2009). The Power of TV: Cable Television and Women's Status in India. *The Quarterly Journal of Economics*, 124(3), 1057-1094. <https://doi.org/10.1162/qjec.2009.124.3.1057>
- Kansanga, M.M., Braimah, J.A., Antabe, R., Sano, Y, Kyeremeh, E., & Luginaah, I. (2018). Examining the association between exposure to mass media and health insurance enrolment in Ghana. *The International Journal of Health Planning and Management*, 33(2), 531-540. <https://doi.org/10.1002/hpm.2505>
- Kotler, P., & Zaltman, G. (1971). Social Marketing: An Approach to Planned Social Change. *Journal of Marketing*, 35(3), 3-12. <https://doi.org/10.2307/1249783>
- La Ferrara, E., Chong, A., & Duryea, S. (2012). Soap Operas and Fertility: Evidence from Brazil. *American Economic Journal: Applied Economics*, 4(4), 1-31. <https://pubs.aeaweb.org/doi/pdfplus/10.1257/app.4.4.1>
- Lavidge, R.J., & Steiner, G. A. (1961). A Model for Predictive Measurements of Advertising Effectiveness. *Journal of Marketing*, 25(6), 59-62. <https://doi.org/10.2307/1248516>
- Machiyama, K., & Cleland, J. (2014). Unmet need for family planning in Ghana: the shifting contributions of lack of access and attitudinal resistance. *Studies in family planning*, 45(2), 203-226. <https://doi.org/10.1111/j.1728-4465.2014.00385.x>
- MacQuarrie, Kerry L. D. (2014). Unmet Need for Family Planning among Young Women: Levels and Trends (DHS Comparative Reports No. 34). ICF International. <https://dhsprogram.com/pubs/pdf/CR34/CR34.pdf>
- Marrone, G., Abdul-Rahman, L., De Coninck, Z., & Johansson, A. (2014). Predictors of Contraceptive use Among Female Adolescents in Ghana. *African Journal of Reproductive Health / La Revue Africaine de La Santé Reproductive*, 18(1), 102-109. <http://www.jstor.org/stable/24362498>
- Ministry of Health, Ghana. (2015). Day of dialogue on family planning in Ghana: Implications of the 2014 DHS findings for family planning programming in Ghana. La Palm Royal Beach Hotel, 7th July 2015. <https://ghana.unfpa.org/sites/default/files/pub-pdf/Family%20Planning%20Dialogue%20Report.pdf>
- Ministry of Health, Ghana. (2020). Ghana Adolescent Reproductive Health Project: Sharing best practices.

- Naidoo, Y., Joubert, L., Nhakaniso, K., Nzeribe, E., Akinsolu, F. T., Okova, D., Chiwire, P., & Lukwa, A. T. (2024). Socioeconomic determinants of male contraceptive use in South Africa: a secondary analysis of the 2016 SADHS data. *BMC Public Health*, 24, 2756. <https://doi.org/10.1186/s12889-024-20295-1>
- Nawaz, S. (1998). *Mass media in development: An overview*. International Monetary Fund.
- Nketiah-Amponsah, E., Arthur, E., & Aaron, A. (2012). Correlates of Contraceptive use among Ghanaian women of Reproductive Age (15-49 Years). *African Journal of Reproductive Health / La Revue Africaine de La Santé Reproductive*, 16(3), 155–170. <http://www.jstor.org/stable/23485703>
- Novignon, J., Lanko, C., & Arthur, E. (2021). Political economy and the pursuit of universal health coverage in Ghana: a case study of the National Health Insurance Scheme. *Health Policy and Planning*, 36, 14-21. <https://doi.org/10.1093/heapol/czab061>
- Olaleye, D. O., Bankole, A. (1994). The impact of mass media family planning promotion on contraceptive behavior of women in Ghana. *Population Reserach and Policy Review*, 13, 161–177. <https://doi.org/10.1007/BF01080201>
- Orozco-Olvera, V. H., Malhotra, N. (2023). Media and Health Outcomes. In: Zimmermann, K.F. (eds) *Handbook of Labor, Human Resources and Population Economics*. Springer, Cham. https://doi.org/10.1007/978-3-319-57365-6_385-1
- Penchansky, R., & Thomas, J. W. (1981). The concept of access: Definition and relationship to consumer satisfaction. *Medical Care*, 19(2), 127–140. <https://doi.org/10.1097/00005650-198102000-00001>
- Rutstein, S. O., & Rojas, G. (2003). *Guide to DHS Statistics*. ORC Macro. https://pdf.usaid.gov/pdf_docs/Pnacy778.pdf
- Rutstein, S. O., & Johnson, K. (2004). *The DHS Wealth Index (DHS Comparative Reports No. 6)*. ORC Macro. <https://dhsprogram.com/pubs/pdf/cr6/cr6.pdf>
- Senderowicz, L., & Maloney, N. (2022). Supply-Side Versus Demand-Side Unmet Need: Implications for Family Planning Programs. *Population and Development Review*, 48(3), 689-722. <https://doi.org/10.1111/padr.12478>
- Sheeran, P., & Taylor, S. (1999). Predicting intentions to use condoms: A meta-analysis and comparison of the theories of reasoned action and planned behavior. *Journal of Applied Social Psychology*, 29(8), 1624-1675. <https://doi.org/10.1111/j.1559-1816.1999.tb02045.x>
- Sneeringer, S. E. (2009). *Fertility Transition in Sub-Saharan Africa: A Comparative Analysis of Cohort Trends in 30 Countries (DHS Comparative Reports No. 23)*. ICF Macro. <https://www.dhsprogram.com/pubs/pdf/CR23/CR23.pdf>
- Solon, G., Haider, S. J., & Wooldridge, J. M. (2015). What Are We Weighting For? *The Journal of Human Resources*, 50(2), 301-316. <http://www.jstor.org/stable/24735988>
- United Nations Department of Economics and Social Affairs. (2020). *World Family Planning 2020 Highlights: Accelerating action to ensure universal access to family planning*. https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2020/Sep/unpd_2020_worldfamilyplanning_highlights.pdf
- Wang, H., Otoo, N., & Dsane-Selby, L. (2017). *Ghana National Health Insurance Scheme: Improving Financial Sustainability Based on Expenditure Review*. The World Bank. <https://doi:10.1596/978-1-4648-1117-3>
- Weber RA, Limange J, Acosta A, Wolff L & Tweedie I (2011). *Ghana Behavior Change Support Project Baseline Survey*. Johns Hopkins Bloomberg School of Public Health Center for Communication Pro-

grams. Baltimore, Maryland. Developed under terms of USAID Cooperative Agreement No. 641-A-00-09-00029- 00. https://ccp.jhu.edu/documents/Ghana%20BCS%20Baseline%20Report_0.pdf

Westoff, C.F. (1988). Is the KAP-gap real? *Population and Development Review*, 14(2), 225–232. <https://doi.org/10.2307/1973570>

Williams, R. (2015). Multicollinearity. University of Notre Dame. <https://www3.nd.edu/~rwilliam/stats2/111.pdf>

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data* (2nd ed.). MIT Press.

Zan, L. M., & Rossier, C. (2024) Psychosocial dimensions of access and their association with contraceptive use and intention to use. *BMC Women’s Health*, 24(2). <https://doi.org/10.1186/s12905-023-02841-y>

World Health Organization. (2023). Trends in maternal mortality 2000 to 2020: Estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division. <https://iris.who.int/bitstream/handle/10665/366225/9789240068759-eng.pdf?sequence=1>

11 Appendix

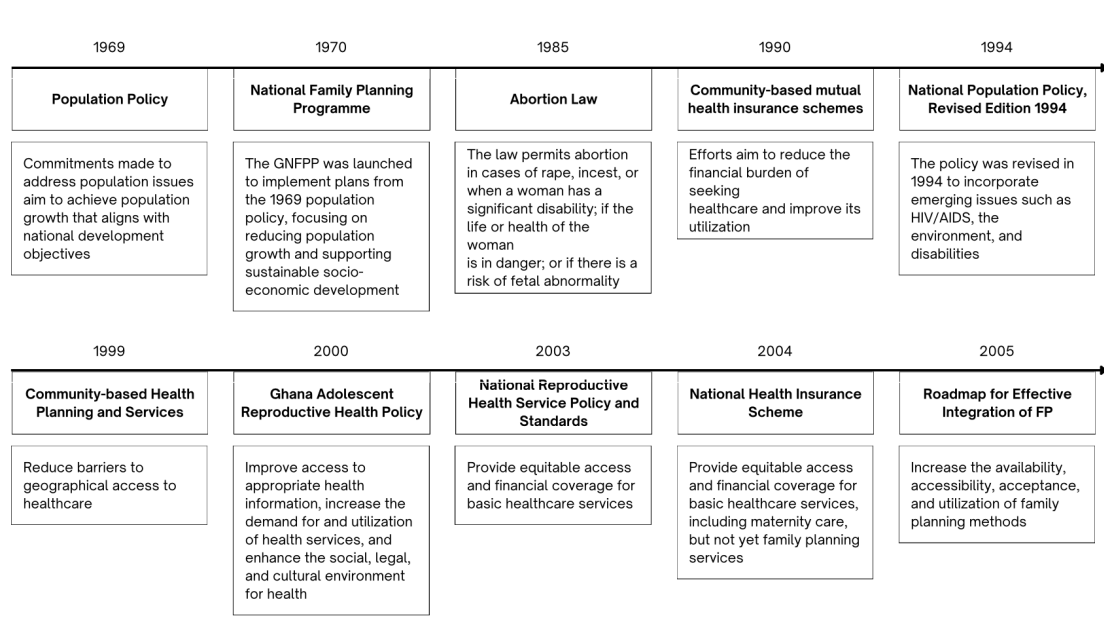


Figure 13: Timeline of Family Planning Initiatives in Ghana 1969-2005. (Authors’ own illustration)

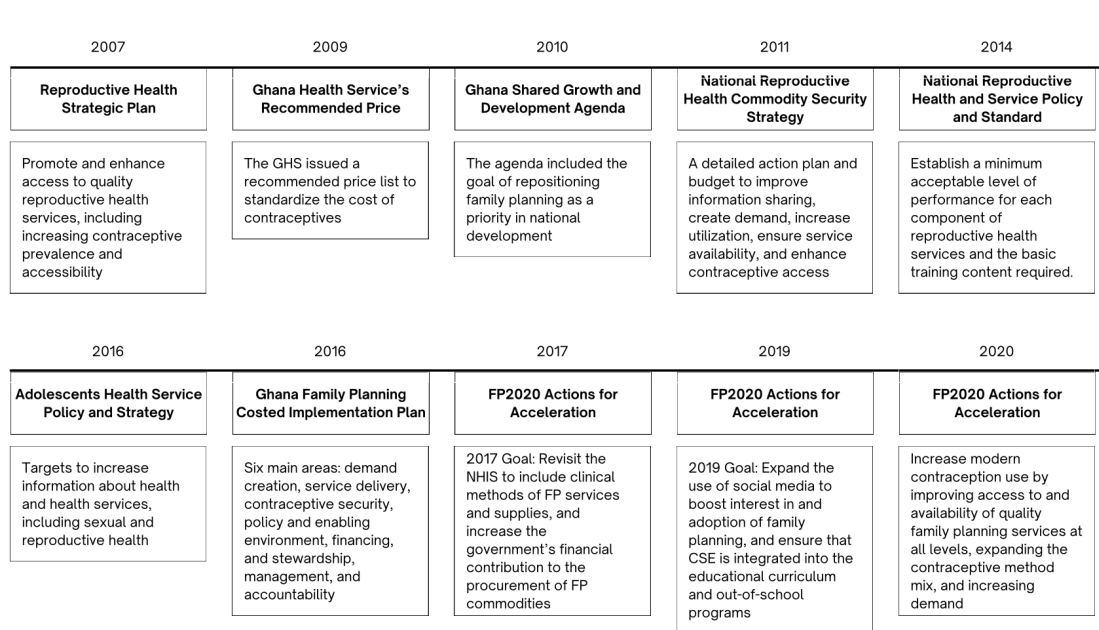


Figure 14: Timeline of Family Planning Initiatives in Ghana 2007-2020. (Authors' own illustration)

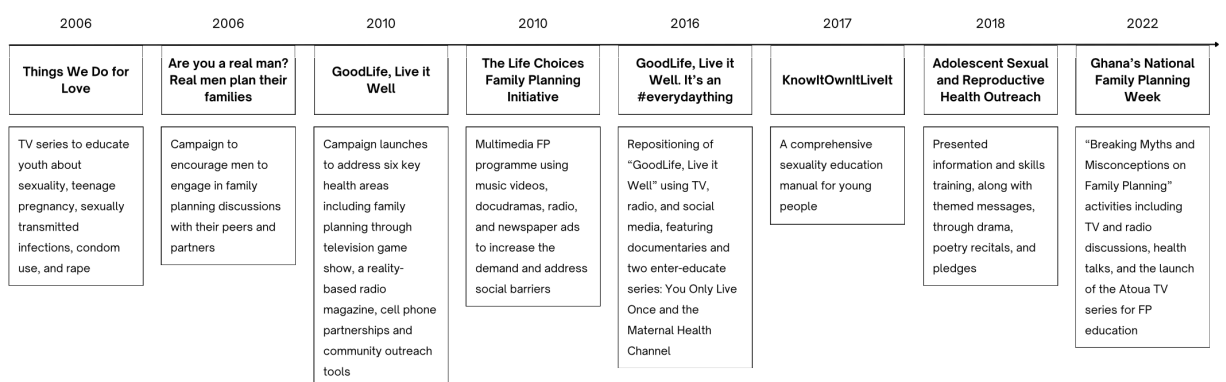


Figure 15: Timeline Family planning Media Campaigns 2006-2022. (Authors' own illustration)

Proportion of Respondents with Mobile Access, Family Planning Exposure, and Internet Use in 2022

Variable	Proportion
Having a mobile phone	81.600
Having a smartphone	45.500
Heard family planning by text messages on mobile phone	5
Seen about family planning on Facebook, Twitter, Instagram, others	10.800
Frequency of internet use (at least once a week)	10.100

Figure 16: 2022 Survey; New Media Channels. Source: GDHS

Weighted Regression Models for Awareness Score with Media Exposure, Controls, and Region Fixed Effects (2003-2022)

	<i>Dependent variable:</i>			
	Awareness Score			
	2003 (1)	2008 (2)	2014 (3)	2022 (4)
Family Planning Exposure (Radio)	0.098*** (0.014)	0.067*** (0.012)	0.047*** (0.012)	0.056*** (0.008)
Family Planning Exposure (TV)	0.076*** (0.013)	0.043*** (0.014)	0.022 (0.014)	0.038*** (0.009)
Family Planning Exposure (Newspaper)	0.033* (0.018)	0.032 (0.022)	0.031 (0.024)	0.002 (0.014)
Constant	0.416*** (0.037)	0.277*** (0.045)	0.507*** (0.043)	0.539*** (0.035)
Observations	2,133	1,884	1,828	2,894
R ²	0.319	0.324	0.278	0.352
Adjusted R ²	0.311	0.315	0.268	0.345
Residual Std. Error	0.187 (df = 2107)	0.183 (df = 1858)	0.155 (df = 1802)	0.155 (df = 2862)
F Statistic	39.438*** (df = 25; 2107)	35.610*** (df = 25; 1858)	27.705*** (df = 25; 1802)	50.210*** (df = 31; 2862)

Note:

* p < 0.1; ** p < 0.05; *** p < 0.01

Control variables (Wealth Index, Education, and Age) included but not shown. Clustered standard errors are reported. Region fixed effects included but not shown.

Figure 17: Weighted model Awareness. Source: GDHS

Weighted Regression Models for Knowledge About Female Cycle with Media Exposure, Controls, and Region Fixed Effects (2003-2022)

	<i>Dependent variable:</i>			
	Knowledge About Female Cycle			
	2003 (1)	2008 (2)	2014 (3)	2022 (4)
Family Planning Exposure (Radio)	0.014 (0.027)	0.107*** (0.027)	0.107*** (0.035)	0.017 (0.030)
Family Planning Exposure (TV)	-0.014 (0.030)	0.042 (0.035)	-0.082** (0.041)	-0.006 (0.033)
Family Planning Exposure (Newspaper)	-0.020 (0.031)	0.080 (0.053)	0.094 (0.075)	0.018 (0.068)
Constant	0.204*** (0.066)	-0.079 (0.070)	0.227* (0.120)	0.347*** (0.095)
Observations	2,133	1,884	1,828	2,894
R ²	0.141	0.181	0.045	0.077
Adjusted R ²	0.131	0.170	0.032	0.067
Residual Std. Error	0.406 (df = 2107)	0.429 (df = 1858)	0.466 (df = 1802)	0.464 (df = 2862)
F Statistic	13.875*** (df = 25; 2107)	16.384*** (df = 25; 1858)	3.415*** (df = 25; 1802)	7.730*** (df = 31; 2862)

Note:

* p < 0.1; ** p < 0.05; *** p < 0.01

Control variables (Wealth Index, Education, and Age) included but not shown.
Clustered standard errors are reported. Region fixed effects included but not shown.

Figure 18: Weighted model Knowledge. Source: GDHS

Weighted Regression Models for Unmet Need with Media Exposure, Controls, and Region Fixed Effects (2003–2022)

	<i>Dependent variable:</i>			
	Unmet Need			
	2003 (1)	2008 (2)	2014 (3)	2022 (4)
Family Planning Exposure (Radio)	0.034 (0.029)	0.020 (0.031)	-0.033 (0.032)	0.007 (0.023)
Family Planning Exposure (TV)	-0.052* (0.029)	-0.039 (0.042)	-0.020 (0.035)	-0.030 (0.026)
Family Planning Exposure (Newspaper)	-0.009 (0.031)	-0.003 (0.045)	0.089 (0.069)	-0.035 (0.051)
Constant	0.468*** (0.079)	0.627*** (0.082)	0.406*** (0.113)	0.199*** (0.072)
Observations	2,133	1,884	1,828	2,894
R ²	0.045	0.039	0.040	0.021
Adjusted R ²	0.034	0.026	0.027	0.011
Residual Std. Error	0.445 (df = 2107)	0.457 (df = 1858)	0.445 (df = 1802)	0.390 (df = 2862)
F Statistic	4.006*** (df = 25; 2107)	3.023*** (df = 25; 1858)	3.014*** (df = 25; 1802)	2.024*** (df = 31; 2862)

Note:

* p < 0.1; ** p < 0.05; *** p < 0.01

Control variables (Wealth Index, Education, and Age) included but not shown. Clustered standard errors are reported. Region fixed effects included but not shown.

Figure 19: Weighted model Unmet Need. Source: GDHS

Variance Inflation Factor (VIF) Results for Selected Covariates

Variable	VIF
Education Level	1.481
Wealth Level	1.789
Family Planning Exposure (Radio)	1.225
Family Planning Exposure (TV)	1.683
Family Planning Exposure (Newspaper)	1.117
Age	1.523

Figure 20: VIF: Variance Inflation Factors, Covariates. Source: GDHS

Breusch-Pagan Test Results for Awareness Model (2003-2022)

Year	BP Test Statistic	P.Value
2003	169.8834	9.132663e-26
2008	95.9408	6.660926e-12
2014	208.5437	2.279434e-33
2022	415.5159	8.470818e-72

Figure 21: Breusch-Pagan Test Results Awareness Model. Source: GDHS

Breusch-Pagan Test Results for Knowledge About the Female Cycle Model (2003-2022)

Year	BP Test Statistic	P.Value
2003	315.2092	6.264981e-55
2008	296.0253	5.234828e-51
2014	59.6055	8.195229e-06
2022	152.5282	7.237146e-20

Figure 22: Breusch-Pagan Test Results Knowledge Model. Source: GDHS

Breusch-Pagan Test Results for Unmet Need Model (2003-2022)

Year	BP Test Statistic	P.Value
2003	82.7010	1.359593e-09
2008	42.3218	2.510462e-03
2014	63.2479	2.212716e-06
2022	54.3754	9.102136e-04

Figure 23: Breusch-Pagan Test Results Unmet Need Model. Source: GDHS

Forward Selection Results for the Awareness Model

Step	Added_Variable	Adjusted_R2	Delta_Adjusted_R2	AIC	Significance	Stars
1	Education level	0.227	0.083	-3,070.860	0	***
2	Wealth index	0.229	0.002	-3,428.750	0	***
3	Number of living children	0.241	0.012	-3,563.040	0	***
4	Partner's education level	0.243	0.002	-3,583.400	0	***
5	Age group	0.244	0.001	-3,596.720	0.0001	***
6	Household has television	0.245	0.001	-3,606.850	0.0004	***
7	Ethnicity	0.246	0.001	-3,616.230	0.001	***
8	Household has radio	0.246	0	-3,617.800	0.059	.
9	Respondent's occupation	0.247	0	-3,617.460	0.027	*
10	Number of children under 5	0.247	0	-3,616.550	0.297	
11	Religion	0.246	0	-3,614.660	0.736	

Figure 24: Forwards Stepwise Selection Method Of Covariates - Awareness. Source: GDHS

Forward Selection Results for the Knowledge Model

Step	Added_Variable	Adjusted_R2	Delta_Adjusted_R2	AIC	Significance	Stars
1	Education level	0.047	0.027	11,524.290	0	***
2	Age group	0.052	0.004	11,484.230	0	***
3	Household has television	0.054	0.002	11,465.440	0	***
4	Household has radio	0.055	0.001	11,460.420	0.008	**
5	Wealth index	0.055	0.001	11,456.220	0.013	*
6	Religion	0.056	0.001	11,451.790	0.011	*
7	Respondent's occupation	0.056	0	11,449.150	0.450	
8	Ethnicity	0.056	0	11,447.750	0.066	.
9	Partner's education level	0.056	0	11,447.840	0.417	
10	Number of children under 5	0.056	0	11,449.530	0.583	
11	Number of living children	0.056	0	11,451.480	0.813	

Figure 25: Forwards Stepwise Selection Method Of Covariates - Knowledge. Source: GDHS

Forward Selection Results for Unmet Need

Step	Added_Variable	Adjusted_R2	Delta_Adjusted_R2	AIC	Significance	Stars
1	Wealth index	0.006	0.002	10,380.270	0.001	***
2	Number of children under 5	0.025	0.019	10,187.550	0	***
3	Number of living children	0.034	0.009	10,092.430	0	***
4	Age group	0.044	0.010	9,994.420	0	***
5	Household has television	0.045	0.001	9,982.770	0.001	**
6	Household has radio	0.045	0.001	9,978	0.009	**
7	Respondent's occupation	0.046	0	9,974.070	0.144	
8	Partner's education level	0.046	0	9,971.540	0.040	*
9	Religion	0.046	0	9,970.770	0.107	
10	Education level	0.046	0	9,971.390	0.240	
11	Ethnicity	0.046	0	9,973.250	0.701	

Figure 26: Forwards Stepwise Selection Method Of Covariates - Unmet Need. Source: GDHS

Reports DHS Categories

Reason For Not Using Contraception	Related Element of Access
Knows no method	Cognitive
Knows no source	Cognitive
Respondent opposed	Psychosocial
Husband opposed	Psychosocial
Others opposed	Psychosocial
Religious prohibition	Psychosocial
Fatalistic	Psychosocial
Lack of access/too far	Geographic
Inconvenient to use	Quality
Side effects	Quality
Costs too much	Financial

Choi et al (2016) DHS Categories

Reason for Not Using Contraception	Related Element of Access
Knows no method	Cognitive
Knows no source	Cognitive
Respondent opposed	Psychosocial
Husband/partner opposed	Psychosocial
Others opposed	Psychosocial
Religious prohibition	Psychosocial
Fatalistic	Psychosocial
Lack of access/too far	Geographic
Preferred method not available	Quality
No method available	Quality
Interferes with body's normal processes	Quality
Inconvenient to use	Quality
Side effects	Quality
Costs too much	Financial

Figure 27: Difference in categorization between this report and that of Choi et al. Source: Choi et al.'s (2016)

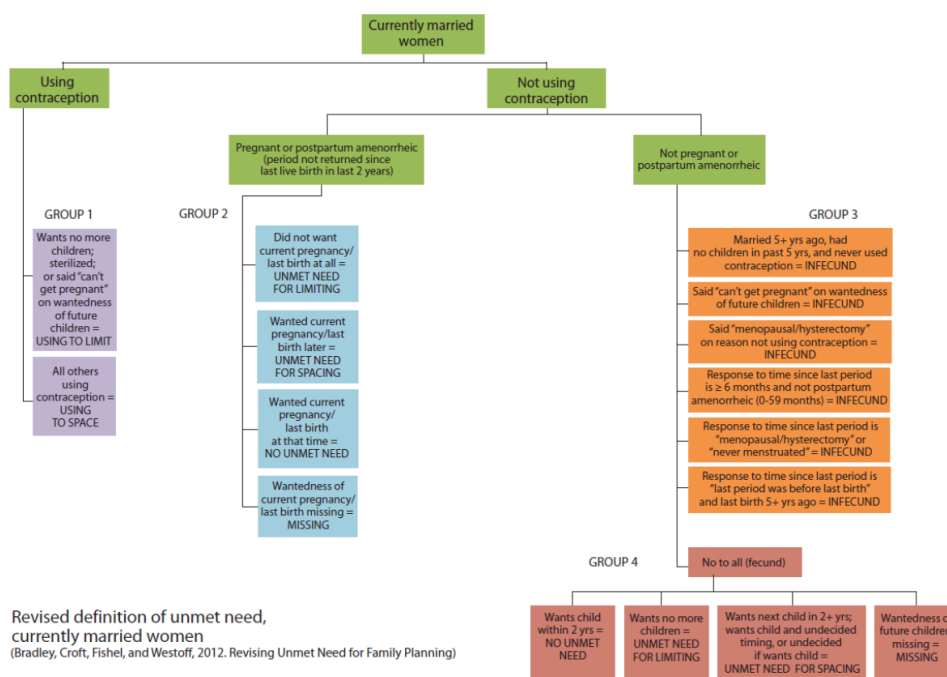


Figure 28: Revised Definition of unmet needs. Source: Westoff et al (2012)

variable	2003	2008	2014	2022
Respondent opposed	2.7	11.62	7.2	12.78
Husband opposed	2.96	5	6.51	6.84
Religious prohibition	2.1	2.25	2.49	0.94
Other opposed	0	0.73	0.47	0.54
Fatalistic	0.11	0.44	5.19	5.98
Know no method	5.56	4.02	0.89	0.11
Know no source	8.59	3.96	0.24	0.15
Fear of side effects	23.83	22.31	38.39	12.03
Costs too much	7.87	2.72	4.23	2.01
Lack of access	3.75	0.65	0.77	0.4
Inconvenient to use	1.25	2.49	4.54	3.32

Figure 29: Reasons for non use 2003-2022. Source: GDHS

Regression Models Using Number of Children Under 5 (v137) as Instrument			
	Dependent variable:		
	media_exposure	knowledge_cycle	
	OLS	instrumental	OLS
	(1)	(2)	(3)
v137	-0.003 (0.003)		
media_exposure		0.964 (1.697)	0.056*** (0.019)
v013	0.009*** (0.002)	0.011 (0.016)	0.019*** (0.003)
v106	0.046*** (0.004)	0.041 (0.079)	0.083*** (0.006)
v190	0.086*** (0.002)	-0.059 (0.147)	0.019*** (0.004)
Constant	0.031*** (0.012)	0.097** (0.043)	0.118*** (0.016)
Observations	8,734	8,734	8,734
R ²	0.253	-0.206	0.054
Adjusted R ²	0.253	-0.206	0.053
Residual Std. Error (df = 8729)	0.269	0.526	0.466
F Statistic (df = 4; 8729)	739.633***		123.967***

Note: *p<0.1; **p<0.05; ***p<0.01

Regression Models Using Number of Dead Children (v228) as Instrument for Awareness			
	Dependent variable:		
	media_exposure	awareness_data	
	OLS	instrumental	OLS
	(1)	(2)	(3)
v228	0.011* (0.006)		
media_exposure		2.462* (1.408)	0.148*** (0.008)
v013	0.009*** (0.002)	-0.006 (0.013)	0.014*** (0.001)
v106	0.046*** (0.004)	-0.040 (0.066)	0.067*** (0.003)
v190	0.086*** (0.002)	-0.185 (0.122)	0.015*** (0.002)
Constant	0.023** (0.009)	0.373*** (0.040)	0.426*** (0.007)
Observations	8,734	8,734	8,734
R ²	0.253	-7.314	0.236
Adjusted R ²	0.253	-7.318	0.235
Residual Std. Error (df = 8729)	0.269	0.653	0.198
F Statistic (df = 4; 8729)	740.184***		672.993***

Note: *p<0.1; **p<0.05; ***p<0.01

Figure 30: Endogeneity analysis; IV Prospects. Source: GDHS.

Regression Models Using Household Has Electricity (v119) as Instrument			
	Dependent variable:		
	media_exposure	knowledge_cycle	
	OLS	instrumental	OLS
	(1)	(2)	(3)
v119	-0.008 (0.005)		
media_exposure		-5.488 (3.869)	0.056*** (0.019)
v013	0.009*** (0.002)	0.069* (0.036)	0.019*** (0.003)
v106	0.047*** (0.004)	0.340* (0.181)	0.083*** (0.006)
v190	0.088*** (0.003)	0.499 (0.335)	0.019*** (0.004)
Constant	0.023** (0.009)	0.247** (0.105)	0.118*** (0.016)
Observations	8,734	8,734	8,734
R ²	0.253	-9.618	0.054
Adjusted R ²	0.253	-9.623	0.053
Residual Std. Error (df = 8729)	0.269	1.562	0.466
F Statistic (df = 4; 8729)	739.942***		123.967***

Note: *p<0.1; **p<0.05; ***p<0.01

Regression Models Using Number of Children Under 5 (v137) as Instrument for Awareness			
	Dependent variable:		
	media_exposure	awareness_data	
	OLS	instrumental	OLS
	(1)	(2)	(3)
v137	-0.003 (0.003)		
media_exposure		-0.555 (0.883)	0.148*** (0.008)
v013	0.009*** (0.002)	0.020** (0.008)	0.014*** (0.001)
v106	0.046*** (0.004)	0.099** (0.041)	0.067*** (0.003)
v190	0.086*** (0.002)	0.076 (0.076)	0.015*** (0.002)
Constant	0.031*** (0.012)	0.443*** (0.023)	0.426*** (0.007)
Observations	8,734	8,734	8,734
R ²	0.253	-0.461	0.236
Adjusted R ²	0.253	-0.461	0.235
Residual Std. Error (df = 8729)	0.269	0.274	0.198
F Statistic (df = 4; 8729)	739.633***		672.993***

Note: *p<0.1; **p<0.05; ***p<0.01

Figure 31: Endogeneity analysis; IV Prospects. Source: GDHS.

Regression Models Using Husband's Educational Level (v701) as Instrument for Awareness			
	Dependent variable:		
	media_exposure	awareness_data	
	OLS	instrumental	OLS
	(1)	(2)	(3)
v701	0.005** (0.002)		
media_exposure		1.791** (0.827)	0.148*** (0.008)
v013	0.009*** (0.002)	-0.0004 (0.008)	0.014*** (0.001)
v106	0.044*** (0.004)	-0.009 (0.039)	0.067*** (0.003)
v190	0.085*** (0.002)	-0.127* (0.072)	0.015*** (0.002)
Constant	0.021** (0.009)	0.388*** (0.026)	0.426*** (0.007)
Observations	8,734	8,734	8,734
R ²	0.253	-3.570	0.236
Adjusted R ²	0.253	-3.572	0.235
Residual Std. Error (df = 8729)	0.269	0.484	0.198
F Statistic (df = 4; 8729)	740.776***		672.993***

Note: *p<0.1; **p<0.05; ***p<0.01

Regression Models Using Respondent's Occupation (v717) as Instrument for Awareness			
	Dependent variable:		
	media_exposure	awareness_data	
	OLS	instrumental	OLS
	(1)	(2)	(3)
v717	-0.001 (0.0005)		
media_exposure		-0.983 (0.855)	0.148*** (0.008)
v013	0.009*** (0.002)	0.024*** (0.008)	0.014*** (0.001)
v106	0.046*** (0.004)	0.119*** (0.040)	0.067*** (0.003)
v190	0.087*** (0.002)	0.113 (0.074)	0.015*** (0.002)
Constant	0.026*** (0.010)	0.453*** (0.024)	0.426*** (0.007)
Observations	8,734	8,734	8,734
R ²	0.253	-1.566	0.236
Adjusted R ²	0.253	-1.568	0.235
Residual Std. Error (df = 8729)	0.269	0.363	0.198
F Statistic (df = 4; 8729)	740.022***		672.993***

Note: *p<0.1; **p<0.05; ***p<0.01

Figure 32: Endogeneity analysis; IV Prospects. Source: GDHS.

Regression Models Using Respondent's Occupation (v717) as Instrument			
	Dependent variable:		
	media_exposure	knowledge_cycle	
	OLS	instrumental	OLS
	(1)	(2)	(3)
v717	-0.001 (0.0005)		
media_exposure		-0.994 (1.284)	0.056*** (0.019)
v013	0.009*** (0.002)	0.029** (0.012)	0.019*** (0.003)
v106	0.046*** (0.004)	0.132** (0.060)	0.083*** (0.006)
v190	0.087*** (0.002)	0.110 (0.111)	0.019*** (0.004)
Constant	0.026*** (0.010)	0.143*** (0.035)	0.118*** (0.016)
Observations	8,734	8,734	8,734
R ²	0.253	-0.293	0.054
Adjusted R ²	0.253	-0.294	0.053
Residual Std. Error (df = 8729)	0.269	0.545	0.466
F Statistic (df = 4; 8729)	740.022***		123.967***

Note: *p<0.1; **p<0.05; ***p<0.01

Regression Models Using Religion (v130) as Instrument for Awareness			
	Dependent variable:		
	media_exposure	awareness_data	
	OLS	instrumental	OLS
	(1)	(2)	(3)
v130	-0.001*** (0.0003)		
media_exposure		0.254 (0.253)	0.148*** (0.008)
v013	0.009*** (0.002)	0.013*** (0.003)	0.014*** (0.001)
v106	0.046*** (0.004)	0.062*** (0.012)	0.067*** (0.003)
v190	0.086*** (0.002)	0.006 (0.022)	0.015*** (0.002)
Constant	0.030*** (0.010)	0.424*** (0.009)	0.426*** (0.007)
Observations	8,734	8,734	8,734
R ²	0.254	0.220	0.236
Adjusted R ²	0.253	0.220	0.235
Residual Std. Error (df = 8729)	0.269	0.200	0.198
F Statistic (df = 4; 8729)	742.077***		672.993***

Note: *p<0.1; **p<0.05; ***p<0.01

Figure 33: Endogeneity analysis; IV Prospects. Source: GDHS.