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GESTATIONAL AGE AT FIRST ANTENATAL CARE VISIT IN RWANDA**Title:**

Pregnancy intention and gestational age at first antenatal care (ANC) visit in Rwanda

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Declaration:

Conflict of Interest – we do not have any conflict of interest to declare

Ethical Approval – This study used secondary data from Demographic and Health Survey (DHS) collected in more than 90 countries and are freely available to the public. The Rwanda DHS survey undergoes ethical review by the Ministry of Health in Rwanda. Further information about ethical clearance can be found on: <https://dhsprogram.com/what-we-do/survey/survey-display-468.cfm>

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ABSTRACT

Background: With antenatal care (ANC) coverage now widely seen as a success story in Sub-Saharan Africa (SSA), attention has begun to shift towards exploring the full life-saving potential that ANC holds.

Objectives: This study examines association between pregnancy intention and gestational age at first antenatal care (ANC) visit in Rwanda, where ANC coverage is nearly universal.

Methods: We use survival analysis and apply the lognormal model in Stata SE 15 to compute time ratios (TR) that provide a direct metric for time to first ANC check-up.

Results: Despite nearly universal coverage, only 25% of pregnant mothers start ANC within the timeframe recommended by WHO. Women with unintended pregnancies are even more likely to delay ANC (TR=11.4%, Z=2.48, $p<0.05$) than women with intended pregnancies. The effect of pregnancy intention on time to first ANC accentuates when we control for parity in the hazard models. There is also educational divide, with early start of ANC limited to pregnant women with secondary education or higher. Interaction effects suggest significant interaction between parity (≥ 4) and unintended pregnancy (TR=11.1%, Z=-2.07, $p<0.05$) on gestational age at first ANC. Other predictors of time to first ANC are contact with health care provider and perceived barriers.

Conclusion: With near universal coverage, the next big challenge to harness the full life-saving potential of ANC in Rwanda would be ramping up prompt start of prenatal care, timeliness of successive checkup intervals, and adherence to recommended number of visits, as opposed to simply increasing attendance. Preventing unwanted pregnancies in multiparous mothers through family planning would also significantly to the goal of universal ANC coverage in Rwanda.

KEYWORDS: gestational age; antenatal care; pregnancy intention; parity; Rwanda; policy

INTRODUCTION

This paper examines the gestational age at which pregnant mothers initiate antenatal care (ANC) in Rwanda. The World Health Organization (WHO) recommends that pregnant mothers get their first ANC check up within 3 months (12 weeks) of pregnancy, with six subsequent visits scheduled at 20, 26, 30, 34, 38 and 40 weeks (WHO 2016).

Initiating ANC in a timely fashion is important, as it can increase the likelihood of adherence to clinically recommended check-up schedule, while providing health care providers with adequate time to identify and effectively treat conditions such as syphilis, anemia, malaria, and hypertension (Rooney and World Health Organization 1992; Carroli et al. 2002). In most parts of Sub-Saharan Africa (SSA), for instance, malaria is endemic and delaying the start of ANC could mean deferring malaria prophylaxis, which can increase the risk of a miscarriage, or result in missed opportunity for early anemia screening and iron supplementation. Starting ANC at the recommended gestational age also allows time for the mother to develop a birth plan in consultation with her family and health care provider. Starting ANC late can also lead to less than recommended number of visits and reduce the overall amount and quality of care for the mother (Lawn et al. 2005; Aldelistein et al. 2009).

Despite growing awareness, delays in ANC persist in SSA. These delays are broadly categorised as delays in seeking, reaching, and receiving ANC. Single or divorced status, lack of education, and distance to health facility are all factors associated with lower likelihood of seeking, reaching and receiving ANC (Magadi et al. 2004; Manzi et al. 2014; Mkandawire 2016). Living in rural area is also associated with less access to ANC (Obermeyer & Potter, 1991). Financial barriers also undermine both early start and quantity of ANC. Households with low monthly income or food insecurity, for instance, are less likely to utilize ANC services (Gebremeskel et al. 2015). Despite the availability of free ANC in many countries in SSA such

as in Ghana, Kenya and Malawi, for instance, out-of-pocket expenses for transport and user fees for certain hospital procedures hinder regular ANC attendance (Birungi & Ouma et al 2013; Pell et al. 2013). Lack of spousal support, perceived poor quality of ANC itself, and late recognition of pregnancy by women contribute to late start of ANC (Gross et al 2012).

A major factor linked to utilization of ANC that continues to receive attention is pregnancy intention. Studies show that a woman's feelings, prior to the pregnancy, regarding whether she had wanted to have the baby and if so, whether, the conception occurred at the appropriate time, affect her attitude and actions towards the pregnancy (Gipson et al. 2008; Singh et al 2010). However, the bulk of this research is still concentrated in the developed world. While still thin, research from SSA similarly show that unplanned pregnancies have consequences for maternal behaviour (Simkhada 2009; Exavery et al. 2013; Thagorappalli et al. 2016). That said, while some of the risky maternal behaviours associated with unintended pregnancy reported by studies coming from Africa are similar to those in the West, others are distinct and relate specifically to the context of SSA. Pregnancy intention related risky maternal behaviour specific to SSA include non-use or inconsistent use of insecticide-treated bed nets, irregular uptake of malaria prophylaxis, and low drive to initiate and sustain exclusive breastfeeding (Chinebuah & Pérez-Escamilla 2001; Manzi et al. 2014; Thagorapalli et al 2016; Mkandawire 2016).

While certainly insightful, these studies raise more questions than answers. For instance, it remains unclear as to what precisely accounts for such risky maternal behaviour in the social and cultural context of SSA. Could it be that mothers who unintentionally get pregnant in SSA are indifferent to seeking advice or support required for positive maternal behaviour? Is it because emotional, economic, and social resources are differentially available between mothers with intended pregnancy and counterparts with unintended pregnancy? Answers to these

questions could help to provide clarity as to why mothers with unintended pregnancy are vulnerable to poor maternal behaviour as well as target policy interventions.

This study contributes to this understanding by measuring the gestational age at which mothers start ANC in Rwanda, and how the timing of this first ANC appointment relates to her prior intention to get pregnant or not. We then examine how the direction and magnitude of this relationship changes when we control for parity.

STUDY SETTING AND METHODS

Setting

Rwanda, formally known as the Republic of Rwanda, is one of the smallest countries on continental Africa. Located in the African Great Lakes region, Rwanda has a total landmass of just over 10,000 square miles (over 26,000 km²) but with an estimated population of 11 million. Despite its small size, Rwanda shares national borders with four different African countries - Uganda, Tanzania, Burundi and the Democratic Republic of the Congo. The economy is showing promising signs of growth, as evident by the near tripling of per capita income from US\$211 in 2001 to \$719 in 2014 (Rwanda Government 2015).

Because of its small landmass, population growth is a major policy preoccupation in Rwanda, and the government tends to see it as a principal constraint to long-term economic growth. Consequently, authorities have always sought to micromanage population growth and restrict it to 'acceptable' trends. For instance, in 1988 the government started *Abakangurambaga*, an initiative intended to 'awaken' Rwandans to embrace the use of modern family planning methods (Ndaruhuye et al. 2009). This helped keep population growth in check until 1994, when the genocide and refugee crisis triggered a population collapse. However, peace building and

reconstruction effort that consumed government attention after the genocide in late 1990 and early 2000 kept family planning temporarily off the radar, until fertility rebound forced the issue back to the top of national policy agenda. This culminated in the formation of a new national family planning policy in 2006.

In addition to the use of social policy, the Rwandan government has over the years pushed for legislation to set a legal ceiling on the number of children that a family can have (Rutanyisire et al. 2014). Although these efforts have met resistance, the Rwandan government is insistent about its concern for uncontrolled fertility and the need for Rwandans to restrain from having more than three children (Westoff 2013; Rutanyisire et al. 2014). This anxiety underpins the design and implementation of all government sponsored family planning and maternal health programs in Rwanda. The issue also dominates local and national elections in the country, greatly helping to shape public sentiment around appropriate family size. In fact, recent opinion polls show that the mean number of children considered appropriate in Rwanda is 3.3, a decline of nearly 50% from 6.1 in 2005 (Rwanda Government 2015). Eighty-nine percent (89%) of Rwandan women and men desire a child sooner than later if they have no prior child, but this figure drops to 17.9% in women and 12.3% in men just after their first child (Rwanda Government 2015).

There has also been significant progress in maternal and child health, as evident by the nearly universal ANC coverage. For instance, ninety-nine percent of women receive at least one ANC from a skilled health provider and this coverage has remained stable since 2010 (Rwanda Government 2015). Challenges persist, however, that threaten Rwanda's maternal health and fertility reduction ambitions. For instance, despite extremely high coverage, only one in four mothers have four or more ANC visits. The coverage of family planning only rose marginally

between 2010 and 2015 15 from 45% to 48%, with one out of every three new clients terminating use of family planning methods within their first year of initiation due to side effects and health concerns (Rwanda Government 2015). Thus, uptake of modern methods of family planning seems to lag behind expectations of reduced family size in Rwanda. This provides important sociopolitical and sociocultural context for understanding the relationship between pregnancy intention and maternal behaviour.

Data

This study uses data from 2014-15 Rwanda Demographic and Health Survey (RDHS) collected in 2014, Rwanda's fifth standard demographic and health survey. RDHS 2014-15 is a nationally representative cross-sectional dataset collected by Rwanda's Ministry of Health in collaboration with the Monitoring and Evaluation to Assess and Use Results (MEASURE) project, funded by the US Agency for International Development (USAID) Measure. Since 1984, DHS MEASURE have supported demographic and health data collection and analysis in more than 90 developing countries. These data facilitate national health research and policy formulation in these countries. Details of the RDHS 2014-15 sampling procedure and techniques are in the final report of the survey itself (Rwanda Government, 2014-15).

Like other DHS datasets, the RDHS 2014-15 data are freely available online, subject to a brief application to DHS MEASURE providing justification for requesting access to the dataset and a statement of commitment to ethical use of the information. The present analysis uses the children's recode in which 7856 women aged between 15 and 49 years responded in a face-to-face interview to survey questions on maternal and child health. To examine the relationship

between pregnancy intention and time to first ANC visit, the present analysis focuses on 639 women reporting being pregnant at the time of the survey.

Variables

The dependent variable for this study is gestational age first ANC visit. In the RDHS 2014-15, females between the ages of 18 and 49 years who reported being pregnant at the time of the survey were asked whether they had received ANC (coded no = 0 and yes = 1) and, if so, they were asked a follow up question to state the time in months from conception to their first ANC visit. The RDHS 2014-15 did not ask directly whether a birth was intended or unintended. Instead, intendedness and un-intendedness are constructs from responses to the question ‘Did you want to get pregnant when you got pregnant?’ The question asks females to think back and describe their pregnancies as wanted then, wanted later, or never wanted. The first of these three responses are interpreted as intended pregnancies at the time of conception, and the latter two are interpreted as unintended pregnancies (coded intended=0, unintended=1). In theory, responses to this question capture the intent of both the mother and her partner although in practice, mother’s report is the standard measure of pregnancy intention.

A single-item indicator measuring contact with family planning provider is used, coded ‘0’ if the mother had not been in contact with a family planning provider in the 12 months prior to the survey and ‘1’ if they had been. Given that exposure to mass media drives various aspects of social change in Rwanda, including reproductive behaviour (Westoff 2013), responses to the question whether the respondent regularly tunes into radio programs, reads newspapers, and watches television are used to construct the variable measuring mother’s exposure to information on safe motherhood. Responses to each of these questions are coded ‘0’ if the respondent never

listens to the programs and '1' if they ever do. Principal Component Analysis (PCA) is used to create a summary measure of the latent construct i.e. exposure to media (Factor loadings 0.70-0.79; Cronbach's alpha = 0.60). Higher scores indicate high exposure to health literature.

Studies have shown that perceived barriers to health care affect utilization of ANC and health services in general (Tweheyo et al. 2010; Matsuoka et al. 2010). The first variable capturing perceived problems regarding access to ANC relates to whether permission from head of household was perceived to be a major problem in seeking medical help coded '0' if no and '1' if yes. The second relates to whether distance to health facility was a major problem in seeking medical help, coded '0' if no and '1' if yes. The third relates to whether perceived absence of a female health provider was as major problem in seeking medical help, coded '0' if no and '1' if yes. Using PCA, the three variables loaded on a single construct (Factor loadings 0.68-0.79; Cronbach's alpha = 0.63). A factor score constructed from questions asking women whether wife beating is justified if wife (i) goes out without telling husband, (ii) argues with husband, and (iii) refuses to have sex with him is used to respondent's tolerance for gender-based violence. Using PCA, these variables loaded on a single construct, and factor loadings ranged from 0.65 to 0.73.

Three additional variables capture respondent's obstetrical and reproductive health history. First, parity, coded '0' if the mother has never given birth to a child with a gestational period of at least 24 months, '1' if one child, and '2' if two children, '3' if three children, '4' if four children or more, with '0' as the reference category. Studies also show that maternal behaviour varies by marital status (Simkhada et al. 2008; Tweheyo et al. 2010), categorized '0' if married, '1' if never married, '3' if living together, and '4' if separated, widowed or divorced.

Third, to eliminate the confounding effect of age on parity, the study controls for age, coded '0' if the mother is 15-24 years, '1' if 25-29 years, '2' if 30-34 years and '3' if 35 years or older.

Maternal behaviour also varies by socioeconomic and demographic factors (Iyaniwura & Yusuf 2009; Mkandawire 2016). In this study, socioeconomic and demographic factors are captured using household wealth quintile, respondent education level, and region of residence. RDHS 2014-14 data offer a measure of household wealth index (poorest, poorer, middle, richer, and richest) that captures a household's overall living standard. Wealth quintiles derive from information about household ownership of selected assets such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities. Of the five categories, 'poorest' is the reference category. Education is coded '0' if no formal education, '1' if primary education, '2' if secondary education, and '3' if higher. Lastly, region of residence is coded '0' if respondent live in East, '1' if South, '2' if West, '3' if North and '4' if the respondent lives in Kigali City, with East as the reference category.

Analytical strategy

This study applies survival analysis to examine the time to first ANC visit. The use of survival analysis is especially appropriate for questions about whether the event occurred and of so when (Singer & Willet 2003). In the context of this study, the question is whether the mother made their first ANC visit and if so at what age of gestation did they do that. A major analytical strength of survival analysis is the ability accounting for censored subjects i.e. mothers who started ANC after the survey data collection (Singer and Willet 2003).

In particular, the study uses lognormal survival models to examine the independent effect of pregnancy intention on the time to first ANC visit, controlling for theoretically relevant

covariates. Lognormal model is preferred over other parametric models because of the overall shape of the hazard function in Fig 1. The lognormal model parameterizes in accelerated failure time metric and estimates directly time to first ANC visit (Lawless 1982). Like other DHS data, the RDHS has a hierarchical structure because the first stage of sampling process involves selecting enumeration areas, and the second stage involves selecting households (women) from the chosen enumeration areas. This means that the responses of women in the same households and enumeration areas may be dependent of each other, which can potentially introduce bias in the estimation of standard errors. STATA 15. SE resolves this potential problem by imposing on the models a “cluster” variable, which adjusts the standard errors and produces statistically robust parameter estimates (Cleves, Gould, & Gutierrez, 2004). Using Stata 15 SE (StataCorp LP), we obtained time ratios (TR) that show how early or late pregnant women with an unintended pregnancy start ANC relative to women with an intended pregnancy.

A TR of magnitude of less than one signifies faster timing or initiating ANC earlier and TR of magnitude greater than one indicates slower timing or initiating ANC later, compared to the reference category. Within the lognormal parametric model, we run the cluster regression option available in Stata to obtain robust standard errors that also adjust for potential bias from sampling design given that, like most demographic and health surveys, RDHS 2014-15 has a multistage sampling design with possible dependence of observations within enumeration areas. We also applied frailty throughout the models to account for unobserved heterogeneity between mothers in the sample and to obtain more robust parameter estimates.

RESULTS

Descriptive statistics

Table 1 shows the frequency distribution of the timing of first ANC visit. Virtually no one reports for ANC during the first month of pregnancy.

<Insert Table 1>

Table 2 shows that the majority of women in Rwanda (55.7%) report that their pregnancy is unintended, and slightly less than half (46.9%) classify their pregnancies as intended. With respect to contact with family planning provider, only 27% had contact with a family planning worker twelve months prior to the survey. With respect to parity, 2.6% of the sample is nulliparous. The sample modal parity is primiparous, with 33.4% of women, while 25% of the women are bi-parous. Twenty two percent (22.8%) are grandparous. The majority of the females are married (59%), while 33% live with a partner. A small percentage are separated, widowed, or divorced (3.76%). With respect to socioeconomic status, the modal wealth quintile is 'poorest' (23.16%) followed by 'poorer' (22.07%). This means that nearly half of Rwandan women are in households located in the bottom 40% of the wealth ladder. Only 15% of the women are in the 'richest' wealth quintile. In terms of education level, the vast majority have primary education (74.33%) and 13% have no formal education at all. Only 9.08% and 2.97% have secondary and higher than secondary level of education, respectively. This means that nearly 1 out of 10 women have secondary or higher level of schooling. Population distribution varies significantly across regions, from only 9.23% in Kigali City to 13% in the North and 27% in the West.

Hazard analysis

In the context of this study, the hazard is the probability of whether and, if so, when a pregnant woman initiates ANC. Smoothed hazard (Figure 1a) shows the pattern of event occurrence i.e. gestational age at which mothers initiate ANC in Rwanda. It shows that the probability of initiating ANC by first trimester, as recommended by WHO, is 0.25 i.e. only one in four pregnant women start ANC prior to the cut-off gestational age of 12 weeks or three months. The hazard function starts high (not from zero) and rises quickly, with a distinctive peak around four months (16 weeks), where the probability of initiating ANC in Rwanda is at its maximum. It then it declines precipitously thereafter. The high initial starting position (0.2) of the hazard function is inevitable under conditions of near universal ANC coverage like in Rwanda, where women, for various reasons, may delay the start of ANC but due to high level of awareness will most likely present themselves for check-up at some point during the pregnancy. The precipitous decline in the hazard probability after the peak period is also inevitable, as there will be late comers to ANC but the numbers will be low at that point.

However, substantial differences emerge when the hazard trajectories of intended and unintended pregnancies are analysed separately, as shown in Figure 1b. Although pregnant mothers in Rwanda generally start ANC late, mothers with unwanted pregnancies delay even more relative to mothers with intended pregnancies. In addition, the vertical distance between the two hazard graphs (the probability differential in initiating ANC at any given gestational age) widens with time and the gap is widest at the gestational age of 5 months. At this gestational age, there is a 30% difference in the probability of initiating ANC if a pregnancy is intended than not. Beyond gestational age of 5 months, both graphs begin to drop, with the vertical distance between separating them gradually narrowing but never closing off. Overall, this means that

although women in Rwanda generally start ANC late, at any given gestational age, women with intended pregnancies are nonetheless more likely to initiate ANC compared to women with unintended pregnancies.

<Insert figures 1a and 1b>

Bivariate analysis

<Insert Table 2>

Table 2 above presents time ratios from the hazard models built with each independent variable. The bivariate analysis suggests that women with unintended pregnancies delayed initiating of ANC relative to women with intended pregnancies (TR=13.5%, Z=2.96, p<0.05). However, women who reported increase exposure to safe motherhood messages by tuning into radio and television or reading a newspaper initiated ANC earlier (TR=6.6, Z=3.39, p<0.05) compared to women with low exposure. On the other hand, women with a perception that they faced fewer barriers accessing health services initiated ANC earlier (TR=6.8%, Z=-3.27, p<0.000). With regard to birth resume, biparous (TR=34.4%; Z=2.81; p<0.05), triparous (TR=49.2%; Z=3.56; p<0.000), and quadparous women (TR=49.8%; Z=49.8%; p<0.000) initiated ANC later compared with nulliparous women. Age was also associated with time to first ANC. Women aged between 30-34years (TR=16.6%; Z=2.64; p=0.05) and above 35years (TR=15.3%; Z=2.09; p<0.05) delayed initiating ANC compared to women aged 24 years and below. Wealth is associated with the start of ANC. Women from households in the richest wealth quintile (TR 10.9%; Z=-2.96; p<0.05) initiated ANC earlier related to women in the poorest wealth quintile. Education is also associated with early start of ANC. Women with secondary education (TR=31.5%; Z=-4.5; p<0.000) or higher (TR=31.5%; Z=-4.31; p<0.000). Being residence in

Kigali City province is associated with earlier start (TR=7.67%, Z=-2.64, p<0.001) of ANC compared to East province.

Multivariate analysis

<Insert Table 3 & 4>

Table 3 shows four multivariate models. The first model examines the effects of pregnancy intention, contact with family planning provider and mass media exposure on gestational age at first ANC visit. The second model captures the effects of gendered barriers and perceived access to health care on gestational age at first ANC. The third model adds variables on the effects of birth resume and reproductive history, which include parity, marital status, and age. The final model examines the effects of socioeconomic and demographic factors; these include household wealth, education attainment and region of residence.

The results show that pregnancy intention is a significant predictor of gestational age at first ANC visit. Mothers whose pregnancies are unintended delay their first ANC visit (TR=11.4%; Z=2.46; p<0.05) compared to mothers whose pregnancies are intended. With respect to contact with family planning provider, mothers who had contact with a family planning worker in the 12 months prior to the survey initiated ANC earlier (TR=5.6%, Z=-2.89, p<0.000) than mothers without such contact.

When variables capturing the effects of gendered barriers and perceived access enter the analysis in model 2, the effect of pregnancy intention on time to first ANC slightly attenuates but the association remains robust. Mothers who reported that a husband is justified to beat his wife if she goes out without permission, argues with him, and refuses to have sex with him are more

likely to delay their first ANC visit (4.5%, $Z=-2.16$, $p<0.05$) compared to mothers who are less tolerant of such intimate partner violence.

Variables capturing birth resume and reproductive health profile enter model 3. As in the bivariate analysis, biparous (TR=42.5%; $Z=3.23$; $p<0.05$), triparous (TR=61.4%; $Z=4.01$; $p<0.000$), and quadparous (TR=63.5%; $Z=3.83$; $p<0.000$) women are more likely to delay starting ANC compared to nulliparous women in the multivariate models. Similarly, age retains its association initiation of ANC, with women aged between 25-29years (TR=11.6%; $Z=-2.05$; $p<0.000$) more likely to report for the first ANC early than women aged 24 and below. However, notably, parity accentuates the association between pregnancy intention and time to first ANC in model 3.

Socioeconomic and demographic variables enter the analysis in model 4. Like in the bivariate analysis, education is a strong predictor of early ANC in the third multivariate model. Mothers with secondary (TR=20.0%, $Z=-2.44$, $p<0.05$) or higher (TR=26.1%, $Z=-2.04$, $p<0.05$) level of education initiate ANC earlier than mothers with no formal education. We detect interaction between parity and pregnancy intention and we run separate interaction model stratified by pregnancy intention (Table 4). In the interaction model, high parity (TR=11.1%, $Z=-2.07$, $p<0.05$) in unintended pregnancies predict late start of ANC.

DISCUSSION

Although coverage of ANC is near universal in Rwanda, the findings of this study shows that only about a quarter of pregnant women initiate ANC by first trimester as recommended by WHO. Even this estimate is likely a conservative one, given that in low resource settings women tend to rely on the last menstrual period method to gauge conception, a method that often underestimates gestational age (Rosenberg et al. 2009). This means that the challenge now for

Rwanda relates more to the promotion of prompt start of ANC as opposed to simply encouraging pregnant mother to go for check-up. The government should initiate a public education program that relays information emphasising the benefits of early start of ANC and strict adherence to clinically recommended check-up schedule, as opposed to merely wooing pregnant women to make as many check-up visits as possible.

The results of multivariate analysis suggest that women with unintended pregnancies significantly delay the start of ANC relative to counterparts with intended pregnancies. Generally, this finding is consistent with previous studies that suggest an inverse relationship between unwanted pregnancy and overall ANC utilization (Magadi et al. 2000; Idris et al. 2006; Awusi 2009; Simkhada et al. 2009). However, the weight of our findings is a little different because of the scale of the problem; our descriptive analysis shows that unintended pregnancies account for the majority (55%) of pregnancies in Rwanda. In other words, more than one in every two pregnancies are either arrived too soon or never wanted at all in the first.

We also found a marked gradient of gestational age at first ANC across successive levels of parity that accentuates the effect of pregnancy intention on the timing of first ANC. To better understand how parity relates to time to first ANC, we conducted interaction effects analysis that revealed that the joint effect of parity (≥ 4) and unintended pregnancy on gestational age at first ANC in Rwanda is greater than the estimated separate effects of parity and pregnancy intention. This is remarkable because it means that the relationship between pregnancy intention and the gestational age at which mothers start ANC in Rwanda varies depending on the level of parity. In other words, women whose pregnancies are unintended at parity equal to or greater than four delay the start of ANC even more compared to women with equally unintended pregnancies but with lower parity.

Understanding the larger context of the interaction effects requires clarifying what it means to designate a pregnancy as unintended when a woman is near or already grandparous. One explanation is that, having successfully birthed on multiple occasions previously, multiparous women tend to be indifferent about the significance of ANC or feel confident about delivering outside of the health facility (Simkhada et al. 2009; Awusi 2009). However, when one considers the results of the interaction effect within the sociopolitical and sociocultural context of Rwanda, where public opinion has solidified around three as the ideal number children per family, a different interpretation is possible. It may be that women who become pregnant accidentally at a time when they have already met or surpassed the government-desired threshold of three children may be subject to ridicule. These women may feel ashamed because they may consider their pregnancy as unacceptable and in contravention of normative expectations of responsible motherhood. In turn, this group of mothers may respond to this stigma by keeping their pregnancy in secret and away from health workers at ANC, the cheerleaders of government three-child policy.

At the same time, the community may view such pregnancies as needless and this may undermine social support and resources available to the mother to permit the pursuit of appropriate maternal behaviour, including prompt start of ANC. Therefore, we can understand maternal behaviour of multiparous women in Rwanda, especially their propensity for remarkably late start of ANC amidst universal coverage, as linked to social stigma fostered by this new climate where there is a tendency to view high parity pregnancies as odd or socially unacceptable. This kind of stigma is similar to the shame associated with teenage pregnancy to the extent that it also undermines access to community resources and maternal care (Panday et al. 2009; Lewandoski et al. 2012). In view of this, there is need to designate high parity unintended

pregnancies as a priority target for family planning or public education intervention in Rwanda. Our findings also indicate that maternal education predicts early start of ANC in Rwanda, consistent with previous studies, which have reported that education predicts positive maternal behaviour (e.g. Ahmed et al. 2010; Mkandawire 2015). The effect of education on gestational age at first ANC in our analysis is, however, limited to women with higher than secondary education.

In conclusion, this paper examined the effect of pregnancy intention on the timing of first antenatal visit among pregnant females in Rwanda. The analysis suggests that women with unintended pregnancies are significantly more likely to delay initiating ANC. This effect persists even after controlling for the influence of sociodemographic and socioeconomic variables, suggesting pregnancy intention is independently associated with maternal behaviour. The cross-sectional nature of the data limits conclusions of this study and prevent us from drawing a definitive causal relationship between pregnancy intention and time to first antenatal visit. Nonetheless, this study importantly points to the potential role of pregnancy intention in shaping maternal health service utilization within the context of SSA, an issue that has hitherto received little attention compared to similar issues in developed countries.

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Figure 1: Hazard graph of gestational age at first ANC visit in Rwanda

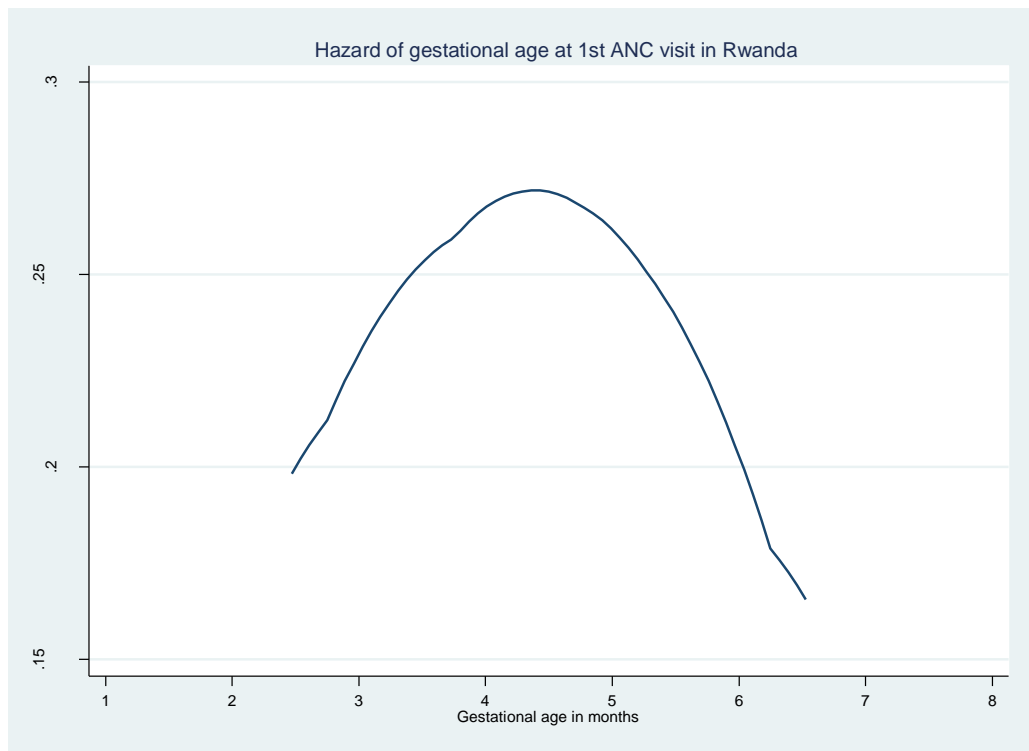
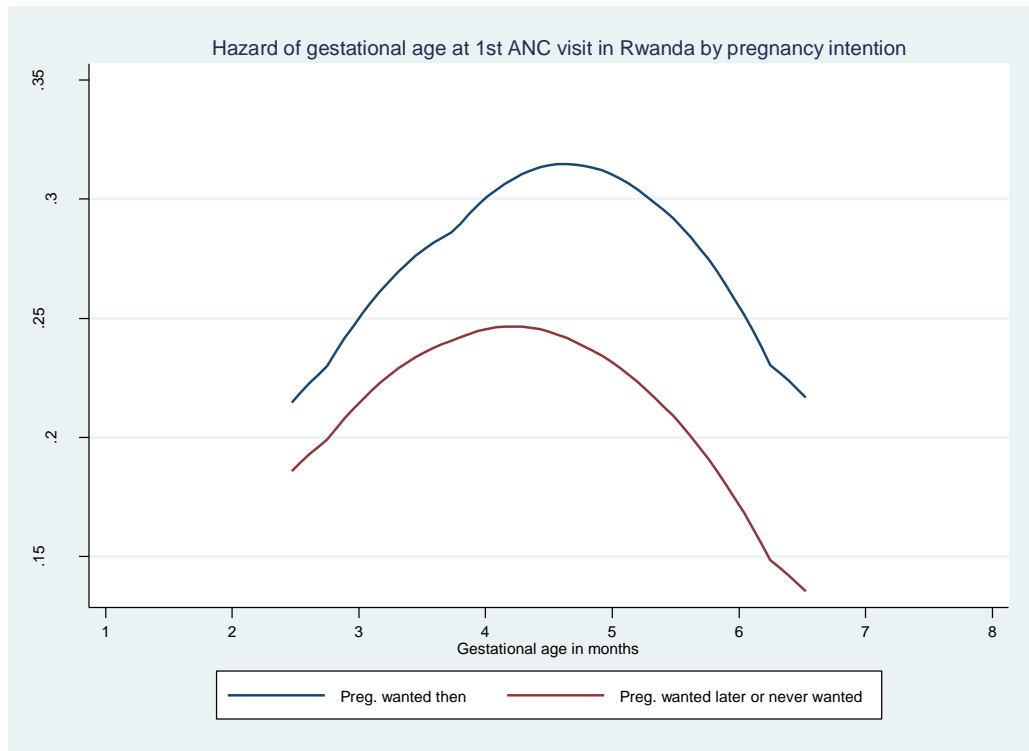


Figure 2: Hazard graph of gestational age at first ANC visit in Rwanda by pregnancy intention

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Table 1: Time of first ANC in months

Month	Number of women	Percent	Cumulative percentage
1	6	0.9	0.9
2	36	5.6	6.6
3	180	28.1	35.6
4	204	31.9	67.2
5	46	7.2	74.4
6	39	6.1	80.5
7	19	3.0	83.5
8	5	0.8	84.3
≥9	104	16.3	100
Total	639		

Table 2: Univariate and Bivariate Analysis of time to first ANC visit in Rwanda (n=639)

Variables	Number (%)	Time Ratio (CI)
<i>Pregnancy intention & information</i>		
Pregnancy wanted then - Yes (ref)	283 (44.29)	1.00
- No	356 (55.71)	1.13(1.04-1.23)**
Visited by FP worker -No (ref)	461 (72.14)	1.00
-Yes	178 (27.86)	0.96(0.87-1.04)
Media exposure to safe motherhood messages (median)	0.543234	0.93(0.89-0.97)**

<i>Sociocultural, physical and financial barriers</i>		
Gender (f-score)		639(mean=0.6651) 1.02(0.97-1.06)
Access (f-score) (physical and financial)		639(mean=0.1232) 0.93(0.89-0.97)**
<i>Birth résumé and personal history</i>		
Parity	None (ref)	17 (2.60) 1.00
	One	214(33.49) 1.07(0.89-1.30)
	Two	161 (25.20) 1.34(1.09-1.65)**
	Three	104 (16.28) 1.49(1.19-1.85)***
	Four or more	143 (22.38) 1.49(1.21-1.84)***
Age	≤24 years	112(17.53) 1.00
	25-29years	216(33.80) 1.02(0.91-1.14)
	30-34years	196(30.67) 1.16(1.04-1.30)**
	≥35years	115(18.00) 1.15(1.00-1.32)*
Marital status	Married	389 (59.78) 1.00
	Never Married	16 (2.50) 0.89(0.76-1.03)
	Living together	217 (33.96) 1.03(0.94-1.13)
	Separated/widowed/Div.	24 (3.76) 0.90(0.75-1.07)
<i>Socioeconomic and demographics</i>		
Wealth quintiles	Poorest (ref)	148(23.16) 1.00

	Poorer	141(22.07)	1.60(0.93-1.12)
	Middle	138(21.60)	1.09(0.96-1.25)
	Richer	111(17.37)	0.97(0.85-1.10)
	Richest	101(15.81)	0.89(0.78-0.99)*
Education	No formal education (ref)	87(13.62)	1.00
	Primary	475(74.33)	0.84(0.74-0.95)*
	Secondary	58(9.080)	0.68(0.58-0.80)***
	Higher	19(2.97)	0.58(0.45-0.74)***
Region of residence	East (ref)	160 (25.04)	1.00
	South	160(25.04)	0.97(0.87-1.09)
	West	173(27.07)	1.05(0.94-1.19)
	North	87(13.62)	0.92(0.80-1.06)
	Kigali City	59(9.23)	0.88(0.75-1.02)
Statistical significance: *p<0.05, **p<0.005, ***p<0.001,			

Table 3 - Multivariate hazard analysis of time to first ANC visit in Rwanda (n=639)

Variables	Model 1	Model 2	Model 3	Model 4
	Time Ratios (CI)	Time Ratios (CI)	Time Ratios (CI)	Time Ratios (CI)
<i>Pregnancy intention and health information</i>				
Pregnancy intended - Yes (ref)	1.00	1.00	1.00	1.00

- No		1.11(1.02-1.21)*	1.09(1.01-1.19)*	1.20(1.03-2.11)*	1.21(1.04-1.99)*
Visited by FP worker	-No (ref)	1.00	1.00	1.00	1.00
	-Yes	0.96(0.88-1.05)	0.96(0.88-1.05)	0.97(0.88-1.06)	0.96(0.88-1.06)
Safe motherhood literacy (f-score)		0.94(0.90-0.98)**	0.95(0.91-0.99)*	0.96(0.91-0.99)*	0.95(0.89-0.99)*
<i>Sociocultural, physical, & financial barriers</i>					
Gender (f-Score)			1.00(0.88-1.05)	1.00(0.96-1.04)	0.99(0.94-1.02)
Perceived barriers (f-score)			0.95(0.91-0.99)*	0.96(0.92-1.00)	1.16(1.02-1.91)*
<i>Birth résumé and reproductive health history</i>					
Parity	None (ref)			1.00	1.00
	One			1.12(0.92-1.25)	1.11(0.92-1.00)
	Two			1.42(1.14-1.76)**	1.40(1.13-1.72)**
	Three			1.61(1.27-2.04)***	1.57(1.25-1.97)***
	≥Four			1.63(1.27-2.10)***	1.60(1.18-1.95)***
Marital status	Married (ref)			1.00	1.00
	Never married			1.03(0.88-1.22)	1.03(0.87-1.23)

	Living together			1.06(0.97-1.16)	1.07(0.97-1.17)
	Sep./widowed/Div.			0.88(0.74-1.05)	0.91(0.76-1.08)
Age	≤24years			1.00	1.00
	25-29years			0.88(0.78-0.99)*	0.89(0.79-1.00)
	30-34years			0.92(0.80-1.04)	0.93(0.82-1.07)
	≥35years			0.85(0.71-1.02)	0.89(0.74-1.07)
<i>Socioeconomic and socio-demographics</i>					
Wealth quintiles (ref)	Poorest				1.00
	Poorer				1.11(0.98-1.25)
	Middle				1.13(0.99-1.25)
	Richer				1.11(0.96-1.27)
	Richest				1.08(0.91-1.29)
Education (ref)	No formal				1.00
	Primary				0.90(0.79-1.02)
	Secondary				0.80(0.66-

				0.95)*
	Higher			0.74(0.55-0.98)*
Region of residence	East (ref)			1.00
	South			1.03(0.91-1.15)
	West			1.03(0.91-1.15)
	North			0.97(0.85-1.11)
	Kigali City			0.95(0.81-1.12)
Sample size	639	639	639	639
Log pseudo likelihood	-547.57	-544.95	-520.50	-514.39
Model sig (Wald)	19.90***	24.96***	88.12***	103.97***
Time Ratios reported for all models. Statistical significance: *p<0.05, **p<0.005, ***p<0.001,				

Table 4: Interaction effects of parity and pregnancy intention in Rwanda (n=639)

Variables	Intended	Unintended
	Time Ratios (CI)	Time Ratio (CI)
<i>Information</i>		
Visited by FP worker -No (ref)	1.00	1.00
-Yes	1.04(0.92-1.18)	0.90(0.79-1.03)

Media exposure - safe motherhood messages (f-score)		0.98(0.93-1.03)	0.97(0.89-1.05)
<i>Sociocultural and perceived barriers</i>			
Gender (f-score)		1.01(0.95-1.07)	0.97(0.88-1.02)
Access (f-score)		1.01(0.95-1.07)	0.94(0.88-1.01)
<i>Birth résumé and personal history</i>			
Parity	None (ref)	1.00	1.00
	One	1.18(0.94-1.49)	0.85(0.65-1.08)
	Two	1.39(0.97-1.59)	1.20(0.88-1.63)
	Three	1.09(0.89-1.97)	1.34(0.97-1.84)
	Four or more	1.56(0.99-2.01)	1.36(1.01-2.71)*
Age	≤24 years	1.00	1.00
	25-29years	0.89(0.76-1.03)	0.84(0.69-1.03)
	30-34years	0.90(0.75-1.07)	0.91(0.74-1.12)
	≥35years	0.84(0.65-1.01)	0.89(0.67-1.17)
Marital status	Married	1.00	1.00
	Never Married	1.40(0.85-2.30)	1.02(0.83-1.24)
	Living together	1.05(0.93-1.19)	1.05(0.92-1.21)
	Separated/widowed/Div.	0.86(0.71-1.03)	0.94(0.75-1.18)
<i>Socioeconomic and demographics</i>			

Wealth quintiles	Poorest (ref)	1.00	1.00
	Poorer	1.12(0.94-1.13)	1.11(0.93-1.32)
	Middle	1.13(0.94-1.36)	1.14(0.94-1.38)
	Richer	0.97(0.80-1.17)	1.26(1.03-1.53)
	Richest	0.91(0.72-1.14)	1.24(0.39-1.04)
Education	No formal education (ref)	1.00	1.00
	Primary	0.91(0.76-1.06)	0.94(0.79-1.13)
	Secondary	0.86(0.70-1.12)	0.82(0.62-1.08)
	Higher	0.83(0.57-1.19)	0.64(0.39-1.04)
Region of residence	East (ref)	1.00	1.00
	South	1.05(0.91-1.22)	1.04(0.87-1.24)
	West	1.08(0.92-1.27)	0.98(0.83-1.16)
	North	0.96(0.81-1.14)	1.00(0.82-1.22)
	Kigali City	1.16(0.94-1.43)	0.84(0.66-1.07)
Statistical significance: *p<0.05, **p<0.005, ***p<0.001,			