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Effects of contraceptive use and antenatal care utilization on risks of pregnancy losses among reproductive women in Tanzania

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Research Article

Keywords: Contraceptive Use, Antenatal Care Utilization, Pregnancy Loss, Reproductive Women, Tanzania

Posted Date: April 27th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9396853/v1

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Additional Declarations: No competing interests reported.

Abstract

Pregnancy loss remains a critical public health challenge in Tanzania, where maternal healthcare access varies significantly across socio-economic groups. This study analyzes determinants of contraceptive use and antenatal care (ANC) utilization and their combined effects on pregnancy loss among women of reproductive age in Tanzania using Tanzania Demographic Health Survey 2022 data. Multinomial logit, double-hurdle model, and Zero-inflated Poisson captured multi-stage decisions and excess zeros. The empirical results reveal that wealth, partner's education, media exposure, and health insurance influence contraceptive use and antenatal care uptake. Adequate ANC attendance and facility delivery reduce pregnancy loss. While the findings indicate that adequate ANC attendance and facility-based delivery significantly reduce the risk of pregnancy loss, the use of modern contraceptives was associated with a higher reported risk, suggesting potential selection bias or underlying issues related to the quality of contraceptive counseling and service timing. The findings underscore the urgency of prioritizing service quality alongside access. Integrated policy interventions should focus on enhancing maternal education and strengthening the continuum of care between family planning and maternal health services to reduce adverse pregnancy outcomes in Tanzania.

1. Introduction

Pregnancy loss is one of the main maternal health challenges globally, affecting millions of women of reproductive age each year. Pregnancy loss refers to the spontaneous loss of an embryo or fetus before viability, including outcomes such as miscarriage, abortion, and stillbirth. Recent global estimates indicate that approximately 38.6 million pregnancy loss cases were recorded in 2021 (Xu et al., 2025), with about 23 million miscarriages and 1.8 million stillbirths occurring annually (UN-IGME, 2024). Despite sustained global efforts to improve maternal health under the Sustainable Development Goals (SDGs), pregnancy loss continues to pose significant health, social, and economic burdens worldwide, with approximately 2.6 million babies being stillborn out of 136 million births in the world (United Nations, 2023; Graham et al., 2016). Evidence shows that pregnancy loss is closely associated with inadequate access to reproductive healthcare services, particularly poor birth spacing and insufficient utilization of antenatal care (ANC) (Yehuala et al., 2025). This underscores the importance of integrated reproductive health interventions, including contraceptive use and adequate antenatal care, in reducing adverse pregnancy outcomes (Stuart et al., 2025).

The burden of pregnancy loss is disproportionately high in low- and middle-income countries, particularly in Sub-Saharan Africa (SSA) which accounts for approximately 48% of global stillbirths, where access to reproductive health services remains limited. (UN-IGME, 2024; Goldenberg et al., 2018). In this region, low contraceptive use contributes to short birth intervals, which increase the risk of adverse pregnancy outcomes, including pregnancy loss (Belachew et al., 2023). Similarly, inadequate and inconsistent utilization of antenatal care services has been strongly linked to poor maternal and neonatal outcomes (Tolossa et al., 2024). Although antenatal care has the potential to promote improved reproductive health behaviors, including postpartum contraceptive uptake (McCarthy et al., 2024), many women in

SSA continue to face barriers to accessing and fully utilizing these services. As a result, limited contraceptive use and suboptimal ANC utilization remain key contributors to pregnancy loss in the region.

In Tanzania, notable progress has been made in expanding maternal and reproductive health services (Mpfubhusa et al., 2026; Prasad et al., 2021). Efforts such as promoting early initiation of antenatal care, the adoption of the eight-contact ANC model to improve the quality and frequency of care, and the decentralization of maternal health services to enhance access, particularly in rural areas, have contributed to increased ANC coverage (Kasagama et al., 2022; MoHCDGEC, 2018; MoHCDGEC, 2021). In addition, the integration of family planning services into broader healthcare programs has improved contraceptive uptake, with approximately 66% of women reported to use some form of contraception (UNFPA, 2018; TDHS-MS, 2022). Despite these achievements, significant challenges persist. The uptake of modern contraceptives remains uneven across regions (Kidayi et al., 2015), while disparities in the timing, frequency, and quality of antenatal care services continue to influence maternal health outcomes (Mahiti et al., 2025; Bintabara & Basinda, 2021). Socioeconomic and demographic inequalities further limit equitable access to reproductive health services in the country.

Despite the growing body of literature on reproductive health, several critical gaps remain. Existing studies on antenatal care in Tanzania and Sub-Saharan Africa largely focus on the determinants of utilization while treating ANC as a single-stage decision, thereby overlooking the intensity and frequency of visits, which are essential for effective maternal care (Ntegwa, 2025; Eliufuo et al., 2024; Tibenderana et al., 2024). In addition, most studies examine contraceptive use and antenatal care separately, without considering their joint and complementary effects on pregnancy loss outcomes, limiting a comprehensive understanding of reproductive health dynamics (Mbona et al., 2025; Ntegwa & Pelizzo, 2025; Endawkie & Tsega, 2025). Furthermore, there exists a contextual gap, as many studies rely on cross-country or regional analyses in Sub-Saharan Africa, which may obscure country-specific differences in healthcare systems and socio-cultural factors relevant to Tanzania (Demissie et al., 2025; Aboagye et al., 2025). Finally, from a methodological perspective, much of the existing literature employs conventional approaches such as descriptive analysis and standard regression models, which do not adequately capture the complexity of healthcare decision-making processes, including multiple choice behavior, two-stage utilization decisions, and excess zero outcomes in pregnancy loss data (Tesema et al., 2021; Eliufuo et al., 2024; Ntegwa, 2025). These limitations highlight the need for a unified analytical framework supported by advanced econometric techniques.

In light of these gaps, this study seeks to address the following research questions: What factors influence contraceptive use among women of reproductive age in Tanzania? What socioeconomic and demographic factors determine both the initiation and intensity of antenatal care utilization? And how do contraceptive use and antenatal care jointly affect the risk of pregnancy loss? By addressing these questions, this study contributes to the literature by integrating contraceptive use and antenatal care within a single analytical framework and applying advanced econometric models, including the

Multinomial Logit Model, Double-Hurdle Model, and Zero-Inflated Poisson Model, to better capture the complexity of reproductive health behaviors and outcomes.

The findings of this study are expected to provide important policy insights for improving maternal and reproductive health interventions in Tanzania. Specifically, the study informs the design of integrated healthcare strategies aims at enhancing equitable access to contraceptive services and improving the adequacy of antenatal care. Ultimately, this contributes to national and global efforts to reduce pregnancy loss and improve maternal and neonatal health outcomes. Furthermore, the study fills the methodological gaps that remain in studying reproductive health by employing double huddle, multinomial logit, and the zero-inflated poisson regression

The remainder of this paper is organized as follows. Section 2 presents the theoretical foundations underpinning the study. Section 3 reviews the relevant empirical literature. Section 4 describes the data sources and outlines the research methodology. Section 5 presents the study's empirical results, while Section 6 discusses the key findings in the context of existing literature. Section 7 summarizes the study and highlights its policy implications. Section 8 outlines the study's limitations and suggests directions for future research.

2. Theoretical Foundation

The Behavioral Model of Health Services Use, as revised by Andersen (1995), provides a sociological framework for analyzing contraceptive use and antenatal care (ANC) uptake. It posits that healthcare utilization is influenced by predisposing characteristics, enabling resources, and perceived need. In the Tanzanian context, realized access to services is shaped by maternal education, wealth quintiles, and the distance to health facilities, which act as structural barriers to service utilization (Gebrekidan et al., 2025; Mpfubhusa et al., 2026). Andersen's model thus highlights the role of service entry barriers in shaping maternal health behaviors.

Complementing this, Grossman's (1972) Health Capital Model offers an economic perspective, framing health as a form of capital that individuals invest in to maintain or improve. Contraceptive use and intensive ANC visits, within this framework, are strategic investments that preserve health capital and prevent its rapid depreciation, which clinically manifests as pregnancy loss (Endawkie & Tsega, 2025). Grossman's model emphasizes the economic costs of health production, including opportunity costs and travel time, which can reduce ANC uptake despite adequate health knowledge (Yehuala et al., 2025; Mpfubhusa et al., 2026).

Integrating these perspectives allows for a comprehensive framework for understanding maternal health in Tanzania. Andersen's model explains how social structures and personal characteristics influence service utilization, while Grossman's model captures the economic rationale driving individuals to make health-preserving decisions. For instance, educated women may understand the benefits of ANC but still face high "shadow prices" for accessing care, affecting utilization and maternal outcomes (Tibenderana et al., 2024).

3. Empirical Literature Review

3.1 The Contraceptive use and risk of pregnancy loss

Contraceptive use among women of reproductive age has been widely studied, but offers mixed results and contextual differences. Using Demographic and Health Survey (DHS) data from 23 Sub-Saharan African countries, Demissie et al. (2025) employed a multinomial multilevel model and found that both individual-level factors (such as education and age) and community-level characteristics significantly influence the use of short- and long-acting contraceptive methods. However, the use of pooled cross-country data limits the ability to capture country-specific dynamics, particularly in Tanzania, where regional disparities in healthcare access and cultural practices are pronounced.

Similarly, Bolarinwa et al. (2021) applied spatial and multilevel analysis in Nigeria and revealed that both individual and community-level factors explain variations in contraceptive use. Nevertheless, the study does not explicitly model the relative probabilities of choosing among multiple contraceptive methods, thereby limiting the understanding of heterogeneous choice behavior. In Tanzania, Fente et al. (2025) examined contraceptive discontinuation using a multilevel binary logistic regression model and reported a discontinuation rate of 34%. While informative, the study focuses on discontinuation rather than the initial choice among alternative contraceptive methods, which is essential for understanding reproductive decision-making.

Overall, the literature highlights the importance of socioeconomic and demographic factors in shaping contraceptive use but is limited by both contextual and methodological constraints. Many studies rely on cross-country analyses, while others apply binary models that fail to capture the multinomial nature of contraceptive choice behavior. These limitations justify the application of a Multinomial logit model to analyze the determinants of contraceptive use in Tanzania.

3.2 The antenatal care and risk of pregnancy loss

Antenatal care (ANC) plays a critical role in improving maternal and neonatal health outcomes. Empirical evidence shows that ANC utilization is influenced by factors such as education, income, healthcare accessibility, and reproductive characteristics. Aboagye et al. (2025), using data from Sub-Saharan Africa, found that wealth and educational attainment are key determinants of disparities in ANC utilization. However, the cross-country nature of the study limits its applicability to country-specific contexts such as Tanzania.

In Tanzania, Ntegwa (2025) employed a Poisson regression model and found that education, wealth status, urban residence, and media exposure significantly influence ANC utilization. Despite these insights, the study treats ANC utilization as a single-stage decision, failing to distinguish between the decision to initiate care and the intensity of subsequent visits. Similarly, Eliufuo et al. (2024) used multivariate logistic regression to analyze determinants of adequate ANC visits and found that access to information increases the likelihood of completing recommended visits, while higher parity and partner

violence reduce completion rates. However, the study focuses only on completion and does not capture the two-stage decision-making process.

Furthermore, Tibenderana et al. (2024) analyzed the adequacy of ANC components using a modified Poisson regression model and found that only 41% of women received adequate ANC services. While informative, the study treats ANC utilization as a single outcome, thereby overlooking the distinction between initiation and intensity of care.

Taken together, these studies demonstrate that ANC utilization is influenced by multiple factors but are limited by their one-stage modeling approach, which does not adequately capture the sequential nature of healthcare utilization decisions. This provides strong justification for the use of a Double-Hurdle Model, which allows separate estimation of both the decision and intensity of ANC utilization.

3.3 The antenatal care, contraceptive use, and pregnancy outcomes

A growing body of literature highlights the importance of reproductive health interventions in reducing adverse pregnancy outcomes, including pregnancy loss. Ahmed et al. (2026), using decomposition analysis, found that improvements in maternal healthcare services and increased contraceptive use contributed significantly to reductions in global maternal mortality. However, the study focuses on aggregate outcomes and does not explicitly examine pregnancy loss at the individual level, nor does it account for the count nature of such outcomes.

At the country level, Ntegwa and Pelizzo (2025) used Propensity Score Matching to estimate the impact of antenatal care on adverse pregnancy outcomes in Tanzania. They found that adequate ANC reduces such outcomes by 5.6% to 9.3%. However, the study models pregnancy outcomes as a binary variable, thereby ignoring the frequency and repeated occurrence of pregnancy loss. Similarly, Mbona et al. (2025) found that contraceptive use reduces the likelihood of pregnancy termination, but the study focuses on termination rather than pregnancy loss, limiting its scope.

At the regional level, Tesema et al. (2021) used a mixed-effects logistic regression model to estimate stillbirth prevalence in East Africa, while Endawkie and Tsega (2025) applied a negative binomial regression model to analyze pregnancy loss in Sub-Saharan Africa. Although these studies provide valuable insights, they do not account for the excess zero counts in pregnancy loss data and fail to jointly analyze the effects of contraceptive use and antenatal care utilization. Additionally, their regional focus limits their applicability to the Tanzanian context.

Overall, the literature is constrained by conceptual, contextual, and methodological limitations, particularly the failure to model the joint effects of contraceptive use and antenatal care and the inability to address the statistical properties of pregnancy loss data. These limitations justify the use of a Zero-Inflated Poisson Model, which accounts for excess zeros and allows for a more robust analysis of the determinants of pregnancy loss.

4. Materials and Methods

4.1 Data

The study utilizes secondary data from the National Bureau of Statistics (NBS) through the Tanzania Demographic and Health Survey (TDHS) 2022. The survey employed a stratified two-stage cluster sampling design to produce nationally representative data covering both Tanzania Mainland and Zanzibar, including urban and rural areas. A total of 40,394 samples, including the women of reproductive age (15–49 years), were included in the dataset. The study focused on key outcome variables such as contraceptive use, antenatal care utilization, and pregnancy outcomes, while also incorporating independent and control variables, including age, education, wealth index, household and family characteristics, and health insurance coverage.

4.2 Variables and measurement

This study employs a range of socio-demographic, economic, behavioral, and reproductive health variables to examine the determinants of contraceptive use, antenatal care utilization, and pregnancy outcomes among women of reproductive age. The variables are measured using binary and categorical scales, consistent with the structure of the TDHS 2022 dataset. Binary variables are coded as 1 to indicate the presence of a characteristic and 0 otherwise, while categorical variables are grouped into meaningful classifications such as age groups, wealth quintiles, education levels, and fertility preferences, as indicated in Table 1

Table 1
The Description and Measurement of Variables

Variables	Description	Measurement
Sex	The gender of the household head	Binary (1 = male, 0 = female)
Women's Age	The women in the reproductive age group	Categorical (1 = 15–24, 25–34, 35–44, 44 and above)
Radio listening	Whether a respondent heard about the family loaning through the radio	Categorical (1 = yes, 2 = no)
Television watching	Whether a respondent heard about family planning through television	Binary (1 = yes, 0 = no)
Social media use	Whether a respondent heard about family palling through social networks (e.g., Instagram, Facebook, and Twitter)	Binary (1 = yes, 0 = no)
Marital status	The status of whether the respondent is married or not married	Binary (1 = married, 0 = never married)
Residence	The place where the respondent currently lives	Binary (1 = urban, 0 = rural)
Wife beating	The beating of a wife is justified when she refuses to have sex with her husband.	Binary (1 = yes, 0 = no)
Access to health services	Whether the women have accessed the health services for the past twelve months	Binary (1 = yes, 0 = no)
Decision maker	Decision maker on the use of contraceptives	Categorical (1 = respondents, 2 = partner/husband, 3 = the joint decision, 4 = someone else
Chronic illness	Whether a respondent has any chronic illness	Binary (1 = yes, 0 = no)
Family planning awareness	Whether the respondent has been told about family planning when at the health facility	Binary (1 = yes, 0 = no)
Postpartum ovulation	Can women get pregnant after birth and before the period	Binary (1 = yes, 0 = no)
Insurance coverage	Whether the respondent is **currently covered by any type of health insurance.**	Binary (1 = yes, 0 = no)

Source: Compiled by authors

Variables	Description	Measurement
Wealth index	The wealth measure of a household's **economic status** is based on the assets and living conditions	Categorical (1 = poorest, 2 = poorer, 3 = middle, 4 = richer, 5 = richest
Fertility preference	A person's or a couple's **desire to have children**	Categorical (1 = have another child, 2 = no more, 3 = infecund
Partners/husband's education	The highest level of education attained by a partner or a husband	Categorical (1 = no education, 2 = primary education, 3 = secondary education, 4 = higher education)
Husband's desire for children	Indicate the husband's preference regarding having additional children in the family.	Binary (1 = yes, 0 = no)
Waiting time	The respondents waited at the health facility before getting the service	Binary (1 = yes, 0 = no
Distance to the facility	Whether the distance to the health facility is a big problem or not	Binary (1 = yes, 0 = no)
Pregnancy history	Indicate the woman's record of all previous pregnancies and their outcomes.	Categorical (1 = livebirth, 2 = stillbirth, 3 = miscarriage/abortion
Antenatal care	The number of antenatal care visits (at least 4 visits) during the pregnancy period	Binary (1 = yes, 0 = no)
Contraceptive use	The current method of contraception that the respondent uses	Categorical (1 = traditional, 2 = Modern, 3 = non-users)
Place of delivery	The place where the respondent was born	Categorical (1 = at heath facility, 2 = at home, 3 = road,4 = others)
Pressured to be pregnant	Husband or family member pressured the respondent to become pregnant against their will	Binary (1 = yes, 0 = no)
Source: Compiled by authors		

4.3 Model Specification

The study employed three distinct models to examine the effects of contraceptive use, antenatal care (ANC), and the risk of pregnancy loss. First, a multinomial logit model was used to identify the factors influencing contraceptive use among women of reproductive age in Tanzania. Second, a double-hurdle model was applied to analyze the determinants and intensity of antenatal care utilization among pregnant women. Finally, a zero-inflated model was employed to assess the effects of ANC and contraceptive use on the risk of pregnancy loss. Based on these approaches, the following estimable equations were specified for each model

The multinomial logit model is used to model categorical outcomes with more than two categories, e.g., type of contraceptive used (modern, traditional, none). The estimable equation is described as;

$$P\left(Y_i = j\right) = \frac{\exp\left(X_i \beta_j\right)}{1 + \sum_{k=1}^{j-1} \exp\left(X_i \beta_k\right)},\ j = 1,\ 2,\ 3 \ldots \ldots . j - 1$$

1

Where Y_i is the contraceptive use category for woman *i*, X_i is the vector of independent variables (age, wealth, education, etc.), and β_j is the vector of coefficients for category *j*

4.3.1 The double-huddle model

The double-hurdle model analyzes decisions with two stages: the first hurdle examines whether an individual participates in an activity (e.g., attending antenatal care), while the second hurdle models the intensity of participation (e.g., number of visits) using a truncated regression. The truncation accounts for the fact that only participants have non-zero outcomes, ensuring unbiased estimation of the factors affecting intensity (Cragg, 1971). The double huddle model is defined as follows;

Step 1: Participation decision (probit model)

$$D_i = Z_i \gamma\ + \mu_i,\ \ D_i = \begin{cases} 1\, if\, D_i > 0 \\ 0,\ otherwise \end{cases}$$

2

Where, $D_i = 1$ If a woman uses ANC, Z_i is the vector of explanatory variables, γ is the vector of coefficients and μ_i follows a normal distribution $\mu_i \sim N(0,\ 1)$

Step 2: (Intensity – Truncated regression)

$$P\left(Y_i = y \,|D_i\ = 1,\ X_i\right) = \frac{\frac{\lambda_i^{\,y} e^{-\lambda\, i}}{y!}}{1 - e^{\lambda\, i}},\ y = 1,\ 2,\ 3,\ 4 \ldots \ldots\ n$$

3

Where $\lambda\, i = \exp\left(X_i \beta\right),\ X_i$ is the expected number of ANC visits, the denominator adjusts for truncation at zero, *y* is the specific counts, and Y_i is the number of antenatal care visits.

4.3.2 The zero-inflated Poisson (ZIP) model

The Zero-Inflated Poisson (ZIP) model is used to analyze count data characterized by an excess number of zero observations. (Lambert, 1992). The model assumes that the observed zeros arise from two

different processes: one group that will always have zero outcomes (structural zeros) and another group that may have positive counts or zeros generated from a standard Poisson process. (Greene, 2012).

First process: for zero counts (logit model)

$$Pr\left(Y_i = 0 \,|X_i\right) = \pi_{\,i} + (1 - \pi_{\,i})e^{-\lambda\, i}$$

4

Where $\pi_{\,i} = \frac{\exp(W_i\alpha\,)}{1+\exp(W_i\alpha\,)}$

Where W_i is the covariate in the logit model, α is the coefficient in the logistic model

Second process: for non-zero counts

$$Pr\left(Y_i = y \,|X_i\right) = (1 - \pi_{\,i})\,\frac{\lambda\,{}_i^{\,y} e^{-\lambda\, i}}{y!},\; y = 1,\; 2 \ldots\ldots\ldots$$

5

Where, $\lambda\, i = \exp\left(X_i\beta\,\right),\; Y_i$ is the number of pregnancy losses , $\pi_{\,i}$ is the probability of structural zeros, $\lambda\, i\;\; is$ expected count if not a structural zero, X_i is the covariates, β factors associated with the number of losses among women at risk.

4.4 Study Analysis

The study employed STATA 17 to analyze the dataset. Descriptive statistics were first used to examine trends and patterns in household and maternal characteristics before applying the comprehensive models, including the multinomial logistic, double-hurdle, and zero-inflated Poisson models. To ensure the reliability and validity of the estimates, each model was tested against its underlying assumptions and performance indicators, yielding robust, credible results that can inform policymakers and public health interventions. (Wooldridge, 2010).

5. Results

5.1 Household characteristics

Table 2 presents the household and maternal characteristics of the study sample of 40,394 women of reproductive age in Tanzania. The majority of households were headed by males (74.51%), and most respondents resided in rural areas (72.32%). In terms of age, most women were between 35–44 years (40.1%), followed by 25–34 years (31.2%). Media exposure was moderate, with 46.58% of women reporting listening to the radio, 23.89% watching television, and 17.12% using social media. Most women were married (81.24%), and about 27.41% reported that wife-beating was justified if a wife refused sex. Access to health care was reported by 59.11% of women, while 73.02% reported no chronic illness.

The contraceptive use decision was dominated by joint decisions (53.83%), with the respondent alone deciding 31.97% of cases, and the husband/partner in 13.30%. Family planning awareness was relatively low, with 44.71% reporting having been informed at a health facility. Postpartum ovulation knowledge was observed in 52.31% of women, while only 4.96% were covered by health insurance. Regarding economic status, the distribution across wealth quintiles was relatively balanced, with the middle category (22.27%) slightly higher. Fertility preference was almost evenly split, with 44.53% wanting another child, 42.00% not wanting more, and 13.47% undecided. Most partners had at least a primary education (42.58%), while 33.63% had no formal education.

Table 2
Household Characteristics

Variable	Category	Frequency	Percent (%)
Sex of household head	Male	30,099	74.51
	Female	10,295	25.49
Residence	Urban	11,180	27.68
	Rural	29,214	72.32
Women age	15–24	3645	1.32
	25–34	12,622	7.70
	35–44	16,225	14.16
	Above 44	7,902	17.09
Listening to the radio	Yes	18,815	46.58
	No	21,579	53.42
Watching TV	Yes	9,652	23.89
	No	30,742	76.11
Use of social media	Yes	6,916	17.12
	No	33,478	82.88
Current marital status	Never married	7,577	18.76
	Married	32,817	81.24
Beating of the wife	No	29,320	72.59
	Yes	11,074	27.41
Access to health care	Yes	23,878	59.11
	No	16,516	40.89
Decision maker for contraception	Respondent	10,493	31.97
	Husband/partner	4,364	13.30
	Joint decision	17,666	53.83
	Someone else	294	0.89
Chronic illness	No	28,253	73.02
	Yes	12141	26.91
Source: Authors computations			

Variable	Category	Frequency	Percent (%)
Family planning awareness	Yes	10,676	44.71
	No	13,202	55.29
Postpartum ovulation	Yes	21,129	52.31
	No	19,265	47.69
Covered by health insurance	Yes	2,003	4.96
	No	38,391	95.04
Wealth index	Poorest	7,860	19.46
	Poorer	8,079	20.00
	Middle	8,994	22.27
	Richer	8,075	19.99
	Richest	7,386	18.28
Fertility preference	Have another	17,987	44.53
	Undecided	5,441	13.47
	No more	16,966	42.00
Partner/Husband's education	No formal education	13,584	33.63
	Primary education	17,200	42.58
	Secondary education	7,307	18.09
	Higher education	2,303	5.70
Husband's desire for children	Yes	10,524	26.76
	No	20,713	73.24
Waiting time	Yes	10,744	42.13
	No	16,439	57.97
Distance to health facility	Big problem	12,737	31.53
	Not a big problem	27,657	68.47
Pregnancy history index	Live birth	5,745	87.39
	Still birth	790	12.02
	Miscarriage/abortion	39	0.59
Source: Authors computations			

Variable	Category	Frequency	Percent (%)
Contraceptive use	Using a modern method	12,176	30.14
	Using the traditional method	2,447	6.06
	Non-user	25,771	56.98
Pressured to become pregnant	No	31,475	95.91
Antenatal care	Yes	38,342	94.94
	No	2,052	5.06
Source: Authors computations			

Table 2 shows that 94.94% of women reported attending antenatal care, but 31.53% perceived distance to the health facility as a major barrier. Pregnancy history showed that 87.39% had experienced live births, 12.02% stillbirths, and only 0.59% miscarriages or abortions. In terms of contraceptive use, 30.14% were using modern methods, 6.06% traditional methods, and 56.98% were non-users. Notably, 95.91% of women reported not being pressured by family members or husbands to become pregnant. Overall, these findings provide a comprehensive profile of household, socio-economic, and reproductive characteristics relevant for analyzing maternal health behaviors in Tanzania.

5.2 Factors influencing contraceptive use among reproductive women in Tanzania

Table 3 presents results from a multinomial logit model examining factors influencing contraceptive use among reproductive-age women in Tanzania, using non-contraceptive users as the reference category. The model was jointly significant, indicating a reasonably good fit. Women's age significantly influenced contraceptive choice. Women aged 35–44 were 5.47 percentage points more likely to use modern methods compared to women above 44, while women aged 25–34 were less likely to use modern methods but slightly more likely to use traditional methods. Younger women (15–24) were more likely to use traditional contraceptives, suggesting that modern method uptake peaks in middle reproductive ages.

Residence and household wealth also played significant roles. Urban women were slightly less likely to use modern methods but more likely to use traditional methods. Wealthier women, particularly those in the richer and middle categories, were more likely to use modern methods, indicating that economic status positively influences contraceptive uptake. Media exposure showed mixed effects: listening to the radio increased both modern and traditional method use, watching television slightly increased modern method use, while social media use was not statistically significant for modern methods.

Table 3
The multinomial logit model for factors influencing contraceptive use among reproductive women in Tanzania

Non-contraceptive user is the reference category		
Variable	**Modern Method (dy/dx)**	**Traditional Method (dy/dx)**
Household head	-0.0036*** (0.0003)	-0.0000 (0.0002)
Women's age		
15–24	0.0244 (0.0066)	0.0170*** (0.0036)
25–34	-0.0203*** (0.0042)	0.0086*** (0.0021)
35–44	0.0547*** (0.0103)	0.0096 (0.0062)
Above 44	Ref.	Ref.
Listening to the radio	0.0164*** (0.0058)	0.0119*** (0.0028)
Use of social media	-0.0039 (0.0041)	0.0147 (0.0022)
Watching TV	0.0010** (0.0046)	-0.0077 (0.0023)
Marital status	-0.1392 (13.6801)	-0.8711 (35.9910)
Residence	-0.0226*** (0.0078)	0.0116*** (0.0039)
Wife beating	0.0039** (0.0030)	0.0063 (0.0013)
Access to health services	-0.0003 (0.0002)	0.0002 (0.0001)
Decision maker on contraceptive use		
Respondent	-0.1045*** (0.0086)	-0.0026 (0.0048)
Husband/ partner	0.0394*** (0.0063)	0.0373*** (0.0036)
Joint decision of partners	-0.1529*** (0.0172)	-0.2000*** (0.0045)
Other people	Ref.	Ref.
Chronic illness	-0.0273*** (0.0086)	0.0117** (0.0050)
Family planning awareness	0.0347*** (0.0060)	0.0017 (0.0033)
Postpartum ovulation	-0.0087*** (0.0015)	0.0024*** (0.0007)
Covered by health insurance	0.0042** (0.0135)	0.0124 (0.0061)

**** =significance at 1%, ** = significance at 5%, * = significance at 10%, and robust standard errors in parentheses, Ref=reference/benchmark category, LR=likelihood ratio, the coefficient represents the marginal effects (dy/dx)*

Source: Authors computations

Non-contraceptive user is the reference category		
Variable	**Modern Method (dy/dx)**	**Traditional Method (dy/dx)**
Wealth index		
Poor	0.0251** (0.0098)	0.0033 (0.0050)
Middle	0.0521*** (0.0098)	0.0161*** (0.0051)
Richer	0.0610*** (0.0111)	0.0400*** (0.0058)
Poorest	Ref.	Ref.
Fertility preference		
Have another child	0.0105 (0.0189)	0.0314*** (0.0115)
Undecided	0.1256** (0.0385)	0.3972 (0.7924)
Infecund	Ref.	Ref.
Partners/husbands' education		
Primary education	0.3306*** (0.0961)	0.3095*** (0.0470)
Secondary education	0.4760*** (0.1030)	0.0436 (0.0546)
Higher education	0.2662** (0.1258)	−0.1866** (0.0735)
No education	Ref.	Ref.
Number of obs = 23,878 Log likelihood = -19300.635 Pseudo R2 = 0.2533 LR chi2(50) = 2173.38 Prob > chi2 = 0.0000		
*** =significance at 1%, ** = significance at 5%, * = significance at 10%, and robust standard errors in parentheses, Ref=reference/benchmark category, LR=likelihood ratio, the coefficient represents the marginal effects (dy/dx)*		
Source: Authors computations		

Table 3 shows that Household decision-making dynamics strongly influenced contraceptive use. When the husband or partner decided on contraceptive use, women were more likely to use modern and traditional methods. In contrast, joint decision-making significantly reduced the probability of using modern and traditional methods relative to other decision-makers. Women who made decisions alone were less likely to use modern methods.

Health and awareness factors were also significant. Family planning awareness increased the use, while women with chronic illnesses were less likely to use modern methods but more likely to use traditional

methods. Understanding postpartum ovulation slightly reduced modern method use and increased traditional method use.

Fertility preferences and partner education further shaped contraceptive behavior. Women desiring another child were more likely to use traditional methods, while those undecideds were more likely to use modern methods. Partner's education had a strong effect: primary education increased both modern and traditional method use, secondary education increased modern method use, and higher education increased modern method use while reducing traditional method use. Health insurance slightly increased the modern method, but had no significant effect on traditional methods.

5.3 Determinants and intensity of antenatal care utilization among pregnant women

Table 4 shows the Double Hurdle model estimates for the determinants of antenatal care (ANC) utilization (Hurdle 1) and the intensity of ANC visits (Hurdle 2) among women of reproductive age in Tanzania. The model was statistically significant, indicating that the included variables jointly influence both the decision to seek ANC and the number of visits attended. Partner or husband's education significantly influenced ANC utilization: women whose partners had primary education were more likely to use ANC services, while secondary education slightly reduced the probability. In terms of intensity, women with partners having primary or secondary education attended fewer ANC visits, as indicated by negative coefficients in Hurdle 2.

Table 4
Double huddle model for determinants and intensity of ANC utilization

Huddle 1 (Determinants)			**Huddle 2 (Intensity of ANC use)**	
Variable	**Coefficient**	**Robust SE**	**Coefficient**	**Robust SE**
Partner/husband's education				
Primary	0.5623**	0.0643	-0.0650***	0.0167
Secondary	-0.1061**	0.0450	-0.0541***	0.0157
Higher	-0.0730	0.0681	-0.0121	0.0174
No education	Ref.	Ref.	Ref.	Ref.
Husbands desire to have children	0.0632**	0.0310	0.00345	0.4097
Women’s age group				
15–24	0.0066***	0.0017	-0.0016***	0.0003
25–34	0.3924**	0.0584	0.0492	0.0046
35–44	0.9273*	0.0754	0.0023	0.0086
Above 44 years	Ref.	Ref.	Ref.	Ref.
Wealth Index				
Poorest	0.1116**	0.0468	0.0240***	0.0087
Middle	0.2404***	0.0497	0.0257***	0.0088
Richer	0.3553***	0.0622	0.0429***	0.0109
Richest	0.3184	0.0799	0.1084	0.0144
Poorer	Ref.	Ref.	Ref.	Ref.
Listening to the radio	-0.1404***	0.0287	0.0057	0.0063
Watching Television	0.0838***	0.0215	0.0061	0.0039
Reading the magazine	-0.0123	0.0266	0.0116**	0.0050
Marital status	-0.0427	0.0807	-0.0172	0.0139
Residence	0.0282	0.0485	-0.0060	0.0084
Waiting time to get service	-0.0241	0.0151	0.0045	0.0033

**** = significance at 1%, ** = significance at 5%, *= significance at 10%, and SE=standard errors, Ref=reference/benchmark category, ANC=antenatal care*

Source: Authors computations

Huddle 1 (Determinants)			Huddle 2 (Intensity of ANC use)	
Variable	**Coefficient**	**Robust SE**	**Coefficient**	**Robust SE**
Pregnancy history	0.0010	0.0008	-0.0004***	0.0001
Live birth	0.236*	0.007	0.4593	0.0052
Still birth	0.0034	0.6457	0.0378*	0.0069
Miscarriage/abortion	Ref	Ref.	Ref.	Ref.
Distance to the health facility	-0.2547***	0.0383	0.0347***	0.0061
Sex of household head	-0.0190	0.0205	0.0106***	0.0034
Marital status	0.0806	0.0535	-0.0062	0.0092
Covered by health insurance	0.0420**	0.0818	0.0171	0.0149
Number of obs = 40,394 Wald chi2(20) = 259.09 Log pseudolikelihood = -37584.559 Prob > chi2 = 0.0000				
*** = significance at 1%, ** = significance at 5%, *= significance at 10%, and SE=standard errors, Ref=reference/benchmark category, ANC=antenatal care*				
Source: Authors computations				

Table 4 further shows that wealth status and women's age were also important determinants. Women in higher wealth categories, middle, richer, and richest, were more likely to use ANC, and the intensity of visits increased notably for the richer group. Younger women aged 15–24 had a small but significant increase in ANC utilization, while women aged 25–34 and 35–44 were more likely to use ANC services. Other factors influencing ANC utilization included media exposure, with television viewing increasing ANC uptake and radio listening reducing it. Pregnancy history, distance to the health facility, and health insurance also significantly affect ANC decisions and intensity of use. Notably, a greater distance to the facility reduced the likelihood of ANC utilization but increased the number of visits among those who sought care.

5.4 Effect of ANC and contraceptive use on risk of pregnancy losses

The Zero-Inflated Poisson model examined the effect of antenatal care (ANC) and contraceptive use on the risk of pregnancy loss among women of reproductive age in Tanzania. The results in Table 5 show that attending ANC significantly reduces the risk of pregnancy loss, while a greater distance to a health facility increases the risk, highlighting the importance of access to maternal health services. Fertility

preferences were strongly associated with pregnancy outcomes: women who desire more children had a higher risk of pregnancy loss, whereas women who were undecided about future fertility had a lower risk compared to infecund women. Partner education also influenced outcomes, with primary and secondary education reducing risk, while higher education was not significant. Place of delivery was critical: home delivery increased the risk, while health facility delivery substantially reduced it.

Table 5
Zero-inflated poisson model for the effect of ANC and contraceptive use on risk of pregnancy loss

Variable	Coefficient	Robust SE	P-value
Antenatal care	-0.0712***	0.0180	0.000
Distance to the health facility	0.0040***	0.0009	0.000
Fertility preference			
More children	0.1426***	0.0258	0.000
Undecided	-0.2859***	0.0472	0.000
Infecund	Ref.	Ref.	Ref.
Partners/husband's education			
Primary education	-0.0703**	0.0287	0.014
Secondary education	-0.2331**	0.0380	0.000
Higher education	0.0478	0.1295	0.712
No education	Ref.	Ref.	Ref.
Wife beating (refuses to have sex)	0.0161	0.0285	0.573
Place of delivery			
Home	0.3492**	0.0023	0.034
Health facility	-0.7232***	0.0056	0.000
Road	0.0023	0.0049	0.569
Others	Ref.	Ref.	Ref.
Marital status	0.0014**	0.0006	0.012
Pressured to be pregnant	-0.0662**	0.0271	0.015
Women's age			
Age 15–24	0.5143***	0.0565	0.000
Age 25–34	0.1073**	0.0560	0.000
Age 35–44	-0.2930	0.0601	0.000
Above 44 years	Ref.	Ref.	Ref.

**** =significance at 1%, ** =significance at 5%, * =significance at 10%, Ref=reference /benchmark category, SE=standard errors, p-value=probability value ranging between 0 and 1*

Source: Authors computations

Variable	Coefficient	Robust SE	P-value
Sex of household head	-0.0161	0.0300	0.591
Wealth index			
Poor	0.0732*	0.0411	0.074
Middle	0.3113***	0.0402	0.000
Richer	-0.4261**	0.0418	0.000
Poorest	Ref.	Ref.	Ref.
Chronic illness	0.0497*	0.0264	0.060
Contraceptive use			
Traditional	-0.2618**	0.0467	0.000
Modern	0.2477**	0.0282	0.000
Non user	Ref.	Ref.	Ref.
Number of obs = 40,394 Log pseudolikelihood = -27087.15 Nonzero obs = 8,193 Zero obs = 32,201 Wald chi2(20) = 1043.17 Prob > chi2 = 0.0000			
**** =significance at 1%, ** =significance at 5%, * =significance at 10%, Ref=reference /benchmark category, SE=standard errors, p-value=probability value ranging between 0 and 1*			
Source: Authors computations			

Table 5 further reveals that maternal age, socio-economic status, and contraceptive use further shaped pregnancy loss risk. Women aged 15–24 had the highest risk, with slight increases among women aged 25–34, while women aged 35–44 showed a lower risk. Wealth index showed a non-linear effect, with middle-income women at higher risk and richer women at lower risk. Chronic illness slightly increased risk, while using traditional contraceptives was protective. Other factors, such as marital status and being pressured to become pregnant, had smaller but significant effects.

6. Discussions

The study provides important empirical insights into the determinants of contraceptive use, antenatal care (ANC) utilization, and their joint effects on pregnancy loss among women of reproductive age in Tanzania. The findings are broadly consistent with established theoretical frameworks, particularly Andersen's Behavioral Model and the Health Capital Model (Andersen, 1995; Grossman, 1972), while also extending the empirical literature by uncovering context-specific and, in some cases, unexpected results.

First, the multinomial logit results confirm that socioeconomic and demographic factors play a significant role in shaping contraceptive use. Consistent with prior studies (Demissie et al., 2025; Bolarinwa et al., 2021; Kidayi et al., 2015), wealth status and partner's education were strong predictors of modern contraceptive uptake. These findings support the argument that higher socioeconomic status enhances both access to reproductive health services and the ability to afford modern contraceptive methods. Similarly, the positive effect of family planning awareness aligns with evidence from Mbona et al. (2025) and UNFPA (2018), which emphasize the importance of information dissemination in promoting contraceptive use. The influence of media exposure, particularly radio and television, further corroborates findings by Bolarinwa et al. (2021) and Demissie et al. (2025), who highlight the role of mass media in shaping reproductive health behaviors across Sub-Saharan Africa.

However, some findings diverge from the existing literature. For instance, the negative association between urban residence and modern contraceptive use contradicts studies that typically report higher uptake in urban areas due to better access to healthcare services (Demissie et al., 2025; Aboagye et al., 2025). A plausible explanation is the existence of intra-urban inequalities, where women living in informal settlements may still face significant barriers to accessing quality reproductive health services (Bintabara & Basinda, 2021; Mahiti et al., 2025). In addition, the finding that joint decision-making reduces contraceptive use contrasts with studies suggesting that spousal communication enhances uptake (Bolarinwa et al., 2021; Demissie et al., 2025). This discrepancy may reflect underlying gender dynamics in Tanzania, where joint decision-making does not necessarily imply equal bargaining power, thereby limiting women's autonomy in reproductive health decisions (Gebrekidan et al., 2025).

Second, the double-hurdle model results provide strong evidence that ANC utilization is a two-stage process influenced by different sets of factors. In line with previous studies (Aboagye et al., 2025; Ntegwa, 2025; Eliufuo et al., 2024), wealth status, education, and access to health services significantly increase the likelihood of ANC utilization. These findings reinforce the view that financial and informational resources are critical determinants of healthcare access. The positive effect of health insurance coverage also supports findings from Gebrekidan et al. (2025) and Prasad et al. (2021), which highlight the role of financial protection and health system strengthening in improving maternal healthcare utilization in Tanzania.

Nevertheless, the study reveals important nuances that extend the literature. For example, while a partner's education increases the likelihood of initiating ANC, it reduces the intensity of visits. This finding contrasts with studies such as Eliufuo et al. (2024) and Tibenderana et al. (2024), which suggest that education improves the adequacy and completion of recommended ANC visits. One possible explanation is that more educated households may perceive fewer visits as adequate or face opportunity costs that limit repeated attendance, as suggested by the Health Capital Model (Grossman, 1972; Yehuala et al., 2025). Furthermore, the finding that distance to health facilities reduces ANC initiation but increases visit intensity among users is consistent with the notion of selective utilization, where only highly motivated women overcome access barriers and subsequently maximize service use (Tolossa et al., 2024; Tibenderana et al., 2024).

Third, the Zero-Inflated Poisson results confirm that both ANC and contraceptive use significantly influence pregnancy loss, supporting the study's main hypothesis. The negative association between ANC attendance and pregnancy loss is consistent with findings by Ntegwa and Pelizzo (2025), Tolossa et al. (2024), and Goldenberg et al. (2018), all of which demonstrate that adequate maternal healthcare reduces adverse pregnancy outcomes. Similarly, the strong protective effect of health facility delivery aligns with global evidence emphasizing the importance of skilled birth attendance in improving maternal and neonatal outcomes (Goldenberg et al., 2018; United Nations, 2023).

However, the findings on contraceptive use present a mixed and somewhat unexpected pattern. While traditional contraceptive methods are associated with a reduced risk of pregnancy loss, modern methods are linked to an increased risk. This contradicts much of the existing literature, which generally finds modern contraception improves reproductive health outcomes (Ahmed et al., 2026; Mbona et al., 2025; Stuart et al., 2025). A possible explanation is selection bias, where women using modern contraceptives may have prior reproductive health complications, making them more susceptible to pregnancy loss (Endawkie & Tsega, 2025). Additionally, improper or inconsistent use of modern methods may reduce their effectiveness, highlighting gaps in counseling and service quality (McCarthy et al., 2024). This finding suggests that access alone is insufficient; the quality of reproductive health services is equally important.

The study also finds that younger women (15–24 years) face a significantly higher risk of pregnancy loss, which is consistent with previous research (Yehuala et al., 2025; Endawkie & Tsega, 2025) linking younger maternal age to biological vulnerability and lower healthcare utilization. The non-linear relationship between wealth and pregnancy loss, where middle-income women face higher risks compared to richer women, further supports findings by Aboagye et al. (2025) and Bintabara and Basinda (2021) who found that persistent inequalities in maternal health outcomes. This suggests that improvements in income alone may not guarantee better health outcomes without corresponding improvements in healthcare access and quality.

Overall, this study makes several important contributions to the literature. Unlike previous studies that examine contraceptive use and ANC separately (Ntegwa, 2025; Mbona et al., 2025; Eliufuo et al., 2024), this study integrates both factors within a single analytical framework, demonstrating their complementary effects on pregnancy outcomes. Methodologically, the application of multinomial logit, double-hurdle, and zero-inflated Poisson models addresses key limitations in prior research by capturing multi-stage decision-making processes and the excess zero nature of pregnancy loss data (Tesema et al., 2021; Endawkie & Tsega, 2025; Demissie et al., 2025).

7. Conclusion

This study examined the determinants of contraceptive use and antenatal care (ANC) utilization, as well as their combined effects on pregnancy loss among women of reproductive age in Tanzania. The findings show that reproductive health behaviors are strongly influenced by socioeconomic and

demographic factors, including wealth, education, media exposure, and health insurance. While these factors generally improve access to modern contraception and ANC services, some variations, such as lower contraceptive use in urban areas and differences in ANC visit intensity, highlight important contextual and behavioral dynamics.

Importantly, the results confirm that adequate ANC utilization and health facility delivery significantly reduce the risk of pregnancy loss. However, the mixed effects observed for contraceptive methods suggest that improving access alone is not sufficient; the quality of services, proper usage, and informed decision-making are equally critical.

From a policy perspective, several implications emerge. First, there is a need to strengthen family planning programs by enhancing education, awareness, and counseling to ensure the correct and consistent use of contraceptive methods. Second, improving both access to and the quality of ANC services is essential, with emphasis on encouraging women to complete the recommended number of visits. Third, addressing structural barriers such as distance to health facilities is crucial, particularly in rural and underserved areas, through improved infrastructure and community-based healthcare services. Fourth, promoting women's autonomy and empowerment in reproductive health decision-making is vital for increasing the uptake of both contraceptive and maternal healthcare services.

In conclusion, the study underscores the importance of integrated and context-specific reproductive health policies that simultaneously address contraceptive use, ANC utilization, and healthcare quality. Such a comprehensive approach is essential for reducing pregnancy loss and improving maternal health outcomes in Tanzania.

8. Limitation and Future Research

Despite providing important insights, this study is subject to several limitations that should be acknowledged. First, the analysis is based on cross-sectional data from the TDHS 2022, which limits the ability to establish causal relationships between contraceptive use, ANC utilization, and pregnancy loss. The observed associations may therefore reflect correlations rather than definitive cause-and-effect linkages. Second, the study relies on self-reported data, which may be affected by recall bias and social desirability bias, particularly for sensitive issues such as contraceptive use and pregnancy outcomes. Third, some potentially important variables, such as quality of healthcare services, cultural beliefs, and provider-related factors, were not fully captured in the dataset, which may lead to omitted variable bias.

Given these limitations, several avenues for future research are recommended. First, future studies should consider using longitudinal or panel data for better trends and patterns on causal relationships and track reproductive health behaviors over time. Second, incorporating qualitative or mixed-method approaches would provide deeper insights into the social, cultural, and behavioral factors influencing contraceptive use and ANC utilization. Third, further research is needed to explore the quality of reproductive health services, including counseling, availability of methods, and provider competence, for better understand their role in shaping outcomes.

Declarations

Funding:

The authors received no financial support for the research, authorship, and/or publication of this article.

Data availability statement

The study used data from the Tanzania Demographic and Health Survey (TDHS) 2022 (Wave 5), obtained from the National Bureau of Statistics (NBS) microdata repository. Data codes are available from the corresponding author upon reasonable request.

Authors contribution

SKM conceptualized the study, developed the introduction, and conducted the empirical literature review. JJK was responsible for the methodology, data analysis, and discussion of the findings. SKM and JJK jointly wrote the conclusion and proofread the final manuscript.

Disclosure statement: The authors report there are no competing interests to declare.

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