Individual and Community-level Determinants of Stillbirth in Southern Ethiopia: A Multi-level Mixed Effect Poisson Regression Analysis

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Article

Individual and Community-level Determinants of Stillbirth in Southern Ethiopia: A Multi-level Mixed Effect Poisson Regression Analysis

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Abstract: Introduction: Ethiopia is one of just ten nations that currently bear the brunt of more than 65% of the stillbirth rate worldwide. Despite significant efforts by the Ministry of Health, the stillbirth rate has declined slowly, remaining substantially higher than the target. This study analyzed broader regional data on stillbirths revealed critical gaps and contributing factors, informing the effective interventions to improve outcomes. **Objective:** To assess individual and community-level determinants of stillbirth in southern Ethiopia. **Methods:** A community-based quantitative cross-sectional study was conducted from October-November 2022. We included all randomly selected 1,130 women who gave live birth in the last 12 months. A multi-stage sampling method to select eligible women. The data were collected by using interviewer-guided structured questionnaire. After each questionnaire was carefully checked for completeness and validity, data were entered into Epi Data, then imported into SPSS software for analysis. The descriptive statistics and mixed effect-multilevel linear regression were performed. The presence and strength of a statistically significant association were assessed using APRs with 95% CIs. **Results:** In a multi-level mixed effect negative binomial analysis, women who had faced health problem during pregnancy had a 66% increased likelihood of stillbirth (APR = 1.66; 95% CI: 1.11-2.46) as compared to women who did not face health problem, the likelihood of stillbirth was 53% lower among women who had planned pregnancy (APR = 0.47; 95% CI: 0.31, 0.73) than their counterparts, the likelihood of stillbirth was 70% lower for those women who resided in high-literacy communities (APR = 0.30; 95% CI: 0.04-0.82) as compared to women who resided in low-literacy communities, one-year increase in women's age at first pregnancy (APR = 0.84; 95% CI: 0.75-0.94) decreased the likelihood of stillbirth by 16%, and one-child increase in women's childbirths (APR = 1.33; 95% CI: 1.21-1.46) led to 33% increase in the likelihood of stillbirth. **Conclusions:** The women facing health problems during the pregnancy, planning current pregnancy, community literacy, women's age at first pregnancy, and parity were significantly associated with stillbirth. The higher keeping good women's health status during the pregnancy, planning for pregnancy, raising community literacy, raising the age of women at first pregnancy, and avoiding parity were recommended.

Keywords: individual and community-level determinants; associated factors; stillbirth; Ethiopia

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1. Introduction

According to the WHO, a stillbirth occurs when a fetus dies in the third trimester (after 28 full weeks of gestation) or when the baby is born weighing more than 1000 g or measuring more than 35 cm [1]. While stillbirth rates have declined worldwide, they are still too high in developing nations. The rate of stillbirths in low- and middle-income countries (LMIC) is ten times greater than that of high-income nations. Ethiopia is one of just ten nations that currently bear the brunt of more than 65% of the stillbirth rate worldwide. Ethiopia is ranked seventh for having a high stillbirth rate [2,3].

The remarkable experience of nine months of pregnancy comes to an abrupt and agonizing end when the baby is born dead. The effects extend beyond the death of the child and include economic, social, and psychological ramifications for parents, families, caregivers, and entire nations. The dynamics of the family and the parents' social environment are impacted by perinatal death. A study also revealed the impact of stillbirths on marriages. Mothers and families who lose a fetus in utero or at birth go through a terrible ordeal [4]. It has been linked to several major psychological problems that affect parents and their families, such as anxiety, depression, fear of becoming pregnant again, and failing at relationships [5]. Women with a history of stillbirth frequently reported higher rates of relationship and mental health issues [6,7].

Several factors that tend to be related to one another contribute to the high stillbirth rates in LMICs. These include lack of education of women, low socioeconomic status, delayed decisions in seeking care, young maternal age, lack of awareness about danger signs, scarce community resources, inadequate maternal nutrition, maternal and fetal medical conditions with supplemnt of the poor response of the health care system [8–10]. An illustration of how these variables are interconnected is the fact that poverty, which is linked to food insecurity, malnutrition, and anemia, is frequently linked to illiteracy. The decisions made by a family regarding seeking care, including recognizing warning signs and obtaining prenatal, delivery, or emergency care, can also be influenced by poverty and low educational attainment. In many resource constraint settings, although women may reach a facility in time for a urgent intervention, it may fail to halt adverse outcomes10.

Most of the stillbirths occur during the intrapartum services and stillbirths are considered an indicator of poor access to and quality of obstetric care [11,12]. It is highly concentrated among rural, poor and marginalised societies where health care system is poor [13]. Ministry of Health of Ethiopia has designed a project to strengthen the health care system particularly improving antenatal care, carry out basic emergency obstetric care and comprehensive emergency obstetric care [14]. Despite the enormous efforts has been made by the Ministry of Health, the rate of still birth has slowly decreased [15], neverthless, the magnitude didn't reach the expected level. The rate of stillbirth has down from 52 deaths/1000 live births in 2000 to 33 deaths/1000 pregnancies in 2016 [16].

Identifying the gaps and factors related to stillbirth through wider regional data provides deep understanding in the effectiveness of interventions. Ultimately, this study will provide policymakers and program implementers with reliable information to improve maternal and child healthcare. Therefore, this study aimed to identify factors that determine stillbirth at individual and community level in Sidama region, Ethiopia.

2. Methods

2.1. Study Area

Northern Zone is a zone in Sidama Region, Ethiopia that is situated 273 kilometers south of Addis Ababa, consists of two towns and eight districts, encompassing 162 kebeles. Its 1.29 million residents include approximately 23.3% women of reproductive age (WRA). Healthcare services are provided by 144 health posts, 36 health centers, one general hospital, and four primary hospitals, with a potential coverage of 70%. The 2022 Sidama Regional Health Bureau reported utilization rates of at least one ANC, HFD, and PNC visit at 90%, 80%, and 70%, respectively [17].

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2.2. Study Design and Population

This community-based, quantitative cross-sectional study, was conducted in Sidama's Northern Zone from October 21 to November 11, 2022, included women of reproductive age (WRA) who had delivered a baby within the previous year and resided in the zone for at least six months. Women unwell during data collection were excluded to ensure informed consent.

2.3. Sample Size Determination

Sample size calculations, using OpenEpi version 3, were based on projected maternal health service (MHS) utilization rates (ANC 74%, HFD 48%, PNC 34%), a 5% margin of error, 95% confidence level, and a design effect of 2.0. The design effect, calculated using the formula DEFF = 1 + (n-1) * ICC (where 'n' represents average cluster size and ICC is the intraclass correlation coefficient), utilized an ICC of 0.05 (based on Donner's recommendation, as prior studies lacked this value), resulting in a minimum of 19.2 clusters. To ensure adequate power, 22 kebeles (clusters) were included. Adjusting for non-response yielded sample size estimates of 613 (ANC), 795 (HFD), and 714 (PNC). A separate calculation, considering variables significantly associated with MHS utilization from previous studies in different Ethiopian regions, resulted in a sample size of 1140. As this was the largest calculated size, 1140 participants were recruited to meet the study's objectives.

2.4. Sampling Technique

A multi-stage sampling method was used to select eligible women. First, four of the zone's eight districts were randomly selected. Second, 22 kebeles were proportionally selected from these four districts using simple random sampling. A house-to-house census identified households with women of reproductive age (WRA) who had given birth in the previous 12 months, creating a sampling frame. Finally, 1,140 women were randomly selected from this frame. Women absent from their household after three consecutive visits during data collection were classified as non-respondents.

2.5. Study Variables

The primary outcome, number of stillbirths in the five years preceding the survey, was a binary variable (1=stillbirth, 0=no stillbirth) based on self-reported data. Independent variables were categorized as individual-level (socioeconomic and demographic factors: maternal age, education and occupation of the woman and her spouse, household wealth index, mass media exposure; obstetric factors: gravidity, parity, maternal age at marriage, experience of obstetric danger signs (ODS), and pregnancy status) and community-level (place of residence, community literacy and poverty levels, community social media use, and distance to the nearest healthcare facility).

2.6. Data Collection Procedures

Data were collected using a structured questionnaire, adapted from previous studies and translated into Sidaamu Afoo (the local language) and back-translated into English to ensure accuracy. Two independent translators, fluent in both languages, performed the translation, with review by the principal investigator (PI) and a third fluent bilingual individual. Following a two-day training, seventeen trained health professionals (each holding a Bachelor's degree and experienced in data collection) administered the pre-tested questionnaire (pre-tested on a 5% sample from Dale District) via the Open Data Kit (ODK) mobile application. Data were collected via face-to-face interviews at participants' homes, with emphasis on clear explanations to minimize reporting bias. Data were daily uploaded to a KoboToolbox server, exported to Stata version 15, and rigorously cleaned and coded before analysis. Daily checks ensured data completeness and consistency.

2.7. Data Analysis Procedure

Data were cleaned, recoded, and categorized before analysis. Descriptive statistics (frequencies/percentages for categorical variables, means/standard deviations for normally

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distributed numerical variables) were generated. Analysis of the five-year stillbirth count began with a Poisson regression model, a standard approach for count data [18]. This model assumes independent observations and equal means and variances for the outcome variable [19]. A core assumption of Poisson regression is equidispersion—that the variance equals the mean of the count outcome variable. Violation of this assumption does not affect the estimates themselves, but it renders parameter inferences unreliable [20]. In our case, the mean and variance were 0.20 and 0.21, respectively. The data were equi-dispersed as a result of the assumption was not violated; hence a multilevel mixed-effect Poisson regression model was fitted to account for between and within clusters variability.

A multilevel Poisson model was employed to account for the hierarchical structure of the data and mitigate potential underestimation of standard errors that might occur with ordinary logistic regression [21], and to yield more reliable standard error estimates [22]. Five models were compared: a null model (Model 0), models with individual-level predictors only (Model 1), community-level predictors only (Model 2), both individual and community-level predictors (Model 3), and a random-coefficient model (Model 4). The random effects model was evaluated using the median odds ratio (MOR) and intraclass correlation coefficient (ICC) [23]. The ICC quantified the proportion of stillbirth variability attributable to kebele clustering, while the MOR estimated unexplained kebele-level heterogeneity—representing the average odds ratio between the lowest- and highest-risk kebeles, with formula, MPR= ~ $e^{0.95*\sqrt{(\text{estimated variance of clusters})}}$ [24]. Model selection was based on the lowest Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and log-likelihood values, and/or a significant likelihood ratio test.

Adjusted analyses used a multilevel mixed-effects binary logistic regression model to account for within- and between-cluster variability. Variables with $p<0.25$ in bivariate analyses were included in the multivariable model [25]. The multivariable analysis controlled for potential confounding. Effect modification was assessed by sequentially adding interaction terms to the model. Multicollinearity was evaluated using multiple linear regression; variance inflation factors (VIFs) below 5 were considered to indicate an acceptable level of multicollinearity [26]. Statistically significant associations were identified using adjusted odds ratios (AORs) and 95% confidence intervals (CIs). A significant association was indicated when the 95% CI for the AOR did not include 1.

2.8. Ethical Clearance

Ethical approval was obtained from the Institutional Review Board of the College of Medicine and Health Sciences at Hawassa University with reference number IRB/076/15. Letter of support was obtained from the Sidama Region Health Bureau, district health offices, and *Kebele* administrators. Written informed consent was obtained from all women and a legal authorized representative or guardian for those women who were less than 18 years old before actual data collection. The aim of the study and methods of data collection, privacy, voluntary participation, potential benefits, and harms were described to the study participants before they signed informed written consent. During the data collection and storage, the confidentiality of the data was assured.

3. Result

3.1. Socio-Demographic and Economic Features of the Participants

From the total of 1,140 study participants, 1,130 study participants took part in the study making a response rate of 99.12%. The mean (± SD) of the age of women was 28.33 (± 6.26) years. The majority of respondents were within the range of 25-29 years old. The largest portion of the study participants identified themselves as being from the Sidama ethnic group (92.7%), and reported following the protestant Christian faith (85.9%), being married (98.1%), and enrolled in formal education (64.6%). More than half, 577 (51.1%) of the study respondents had access to mass media through radio, television, and newspapers (Table 1).

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Table 1. Socio-demographic and economic characteristics of the study participants in the Northern zone of Sidama region, Ethiopia, 2022 (N =1,130).

Variables	Categories	Number	Percent
Age of mothers	15-19	25	2.2
	20-24	289	25.6
	25-29	395	35.0
	30-34	321	28.4
	35-39	94	8.3
	40-44	6	0.5
Ethnicity	Sidama	1048	92.7
	Wolayita	46	4.1
	Amhara	27	2.4
	Gurage	8	0.7
	Oromo	1	0.1
Religions	Protestant christian	971	85.9
	Orthodox christian	42	3.7
	Catholic christian	65	5.8
	Muslim	52	4.6
Mothers' education status	Cannot read and write	298	26.4
	Can read and write only (no formal education)	103	9.1
	Primary school (1-8)	513	45.4
	Secondary school (9-12)	108	9.6
	Above secondary school	108	9.5
Mothers' occupation status	Housewife	866	76.6
	Farmer	39	4.5
	Governmental employee	72	6.4
	Merchant	153	13.5
Marital status	Married	1108	98.1
	Divorced/separated/widowed	22	2
Husband occupation status	Governmental employee	138	12.2
	Merchant	399	35.3
	Farmer	464	41.1
	Daily laborer	93	8.2
	Private organization employee	36	3.2
Husband education status	Cannot read and write	158	14.0
	Can read and write only (no formal education)	174	15.4
	Primary school (1-8)	491	43.5
	Secondary school (9-12)	140	12.4
	Above secondary	167	14.7
Family size	1-5	790	69.9
	>5	340	30.1
Use of mass media	No	553	48.9
	Yes	577	51.1
Wealth quintile	Lowest	226	20.0
	Second	229	20.3
	Middle	223	19.7
	Fourth	226	20.0
	Highest	226	20.0

Note: There were 22 divorced/separated/widowed women in our data. However, we collected data from all women about their husband's occupation and education status by the time they were in marital union.

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3.2. Reproductive Health Characteristics

The mean (± SD) of the age at first marriage of the women was 18.41 (± 2.33) years. Nearly one-fifth (19%) of the women had a previous history of abortion. Approximately two-thirds (63.7%) of the study respondents had given birth to two to four children. Eleven percent of women had experienced a stillbirth at least once. For 68.9% of the women, the last pregnancy was planned (Table 2).

Table 2. Reproductive health and obstetrics characteristics of the study participants in the Northern Zone of Sidama region, Ethiopia, 2022 (N=1,130).

Variables	Categories	Number	Percent
Age at first marriage	18.41 ± 2.33		
Age at first pregnancy	19.70 ± 2.45		
Total number of gravidities	1	162	14.4
	2-4	737	65.2
	≥5	231	20.4
Previous history of abortions	No	910	80.5
	Yes	220	19.5
Number of abortions	No	910	80.5
	1	203	18.0
	≥2	17	1.5
Total number of deliveries	1	218	19.3
	2-4	720	63.7
	≥5	192	17.0
Infection during the current pregnancy	Yes	375	33.2
	No	755	66.8
Family history of hypertension	Yes	142	12.6
	No	988	87.4
Previous history of stillbirth	Yes	126	11.2
	No	1004	88.8
Previous history of neonatal death	Yes	230	20.4
	No	900	79.6
Last pregnancy planned	Yes	779	68.9
	No	351	31.1
Reason for unplanned pregnancy (n=351)	Lack of modern contraceptives	183	52.1
	Failure of contraceptive method	127	36.2
	Others	41	11.7
Encountered ODS during last pregnancy	Yes	244	21.6
	No	886	78.4
Faced ODS during last childbirth	Yes	128	11.3
	No	1002	88.7
Confronted ODS during last postpartum period	Yes	195	17.3
	No	935	82.7

3.3. Determinants of Stillbirth

Women who had faced health problem during pregnancy had a 66% increased likelihood of stillbirth (APR = 1.66; 95% CI: 1.11-2.46) as compared to women who did not face health problem. The likelihood of stillbirth was 53% lower among women who had planned pregnancy (APR = 0.47; 95% CI: 0.31, 0.73) than their counterparts. The likelihood of stillbirth was 70% lower for those women who resided in high-literacy communities (APR = 0.30; 95% CI: 0.04-0.82) as compared to women who resided in low-literacy communities. A one-year increase in women's age at first pregnancy (APR =

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0.84; 95% CI: 0.75-0.94) decreased the likelihood of stillbirth by 16%. A one-child increase in women's childbirths (APR = 1.33; 95% CI: 1.21-1.46) led to 33% increase in the likelihood of stillbirth (Table 3).

Table 3. Determinants of abortion among women of reproductive age in the Northern zone of Sidama region, Ethiopia, 2022 (N = 1,130).

Variables	Category	CPR (95% CI)	APR (95% CI)
Individual level determinants			
Women's education status	Cannot read and write	Ref	Ref
	Can read and write only (without formal education)	0.74 (0.42, 1.29)	1.23 (0.66, 2.32)
	Have formal education	0.44 (0.31, 0.61)	1.10 (0.58, 2.06)
Husband education status	Cannot read and write	Ref	Ref
	Can read and write only (without formal education)	0.90 (0.55, 1.48)	0.65 (0.36, 1.15)
	Have formal education	0.42 (0.26, 0.68)	0.49 (0.24, 1.02)
Use of mass media	No	Ref	Ref
	Yes	0.51 (0.36, 0.72)	0.71 (0.45, 1.13)
Wealth quintile	Lowest	Ref	Ref
	Second	1.01 (0.58, 1.75)	1.27 (0.64, 1.85)
	Middle	0.74 (0.43, 1.29)	1.08 (0.47, 1.41)
	Fourth	0.53 (0.30, 0.93)	0.89 (0.44, 1.42)
	Highest	0.82 (0.48, 1.39)	1.13 (0.51, 1.87)
Age at first pregnancy©		0.82 (0.74, 0.91)	0.84 (0.75, 0.94)**
Number of parity©		1.37 (1.25, 1.49)	1.33 (1.21, 1.46)**
Pregnancy status	Unplanned	Ref	Ref
	Planned	0.30 (0.20, 0.44)	0.47 (0.31, 0.73)**
Husband attitude about maternal health service use	Positive	Ref	Ref
	Negative	1.80 (1.27, 2.55)	1.54 (0.66, 3.60)
Woman's decision-making power	Non-autonomous	Ref	Ref
	Autonomous	0.61 (0.43, 0.87)	1.20 (0.52, 2.78)
Faced health problem during pregnancy	No	Ref	Ref
	Yes	2.08 (1.51, 2.87)	1.66 (1.11, 2.46)*
Faced health problem during childbirth	No	Ref	Ref
	Yes	1.30 (0.84, 2.01)	1.20 (0.71, 2.04)
Road access	Inaccessible	Ref	Ref
	Accessible	0.74 (0.51, 1.06)	0.99 (0.59, 1.67)
Birth preparedness plan	Poorly prepared	Ref	Ref
	Well prepared	1.02 (0.72, 1.44)	1.10 (0.72, 1.67)
Community-level determinants			
Community-level poverty	High	Ref	Ref
	Low	1.93 (0.64, 4.17)	1.34 (0.35, 5.02)
Community-level distance to reach nearest health facility	Big problem	Ref	Ref
	Not big problem	1.80 (0.17, 4.09)	1.48 (0.40, 5.47)
Community-level women literacy	Low	Ref	Ref
	High	0.41 (0.02, 0.79)	0.30 (0.04, 0.82)*

*: significant association ($p < 0.05$); **: highly significant association ($p < 0.01$); CI: confidence interval; ©: continuous variable; Ref: reference group.

3.4. Random Effect Model of Unsafe Abortion

The multi-level logistic regression model fitted better than the ordinary logistic regression model ($p < 0.001$). The ICC value revealed that 26.27% of the variability in prevalence of stillbirth was related to membership in *kebele*s. The final model, even after adjusting for all potential attributable factors,

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revealed that the disparity in prevalence of stillbirth across kebeles continued to be statistically significant. Nearly 19.90% of the variability in prevalence of stillbirth across kebeles was accounted for by *kebele* membership. The MPR value demonstrated that residual heterogeneity between the residential areas when randomly selecting the two individuals in different areas was related to 4.64 times the individual likelihood of stillbirth prevalence. The final model, even after adjusting for all potential attributable factors, revealed that the heterogeneity in stillbirth across residential areas continued to be statistically significant. Further, the effect of the planned pregnancy on stillbirth prevalence showed significant variation across the *kebeles* (variance = 0.02; 95% CI: 0.01-0.25) Table 4 of the supplementary file 1.

3.5. Model Selection Criteria

The model fitness evaluation test of stillbirth showed that the empty model was the least fit (AIC = 834.34, BIC = 844.40, and log-likelihood = -415.17). Yet, there was significant progress in the fitness of the models, particularly in the final model (AIC = 735.00, BIC = 849.02, and log-likelihood = -354.70). Thus, the final model is best fitted as compared to the other models.

4. Discussion

This study primarily assessed individual and community-level determinants of stillbirth in Sidama region, Southern Ethiopia. Accordingly, women facing health problem during pregnancy, planned pregnancy, community-level women literacy, women's age at first pregnancy, and number of parities were significantly associated with stillbirth.

This study revealed that women who had faced health problem during pregnancy had a 66% increased likelihood of stillbirth as compared to women who did not face health problem. This finding is supported by the study finding report from Addis Ababa, Ethiopia [27], United Kingdom [28], and Latvia [29]. Several studies agreed that maternal chronic diseases including high blood pressure, diabetes mellitus, thyroid disorders, blood clotting disorders, systematic lupus erythematous, and obesity were significant contributors to stillbirth [27–29]. In addition, pregnancies complication like oligohydramnios/polyhydramnios, abruptio placenta, and other placental pathologies upon the chronic medical condition further increases frequency of stillbirth [29]. Moreover, maternal exposure to infections is closely related to still birth. Infections like HIV, STIs, tuberculosis, malaria, intestinal helminthiasis, and other protozoal infections have a significant contribution to stillbirths [27,30,31]. These aforementioned infections and other acute febrile illnesses like typhus and typhoid are highly prevalent in the study area [30–32] that health policy makers must work to halt transmission of these infection in pregnant mothers. As researchers, we recommend that the pregnant mothers should be screened for the presence of any medical condition, weather chronic metabolic disorders or acute/chronic infections and to manage accordingly during their ANC follow-up.

This study has revealed that the likelihood of stillbirth was 53% lower among women who had planned pregnancy than their counterparts. This finding is consistent with cohort study findings reported from Sweden [33] and Peru [34]. Planned pregnancies contribute significantly to reducing stillbirths by allowing for better health management and reducing the risk of complications during pregnancy and delivery. Planned pregnancies promotes early detection, timely intervention and management, monitoring fetal growth & development, opportunity to empower women through education, adequate birth spacing, improved nutrition, addressing underlying health conditions, safe delivery practices and improved access to skilled care [33,34]. In general, planned pregnancies create a healthier and safer environment for both mother and baby, leading to a significant reduction in stillbirths. They allow for early detection of complications, access to appropriate care, and improved birth outcomes. In Ethiopia's EDHS 2016 data revealed that 27% of the pregnancies were unplanned [35], hence, we suggest to educate families to benefit from planned pregnancies.

Our study showed that the likelihood of stillbirth was 70% lower for those women who resided in high-literacy communities as compared to women who resided in low-literacy communities. This finding is in concordance with study finding report from Pakistan [36]. Other studies reported that

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women resided in rural community has showed a greater chance of experiencing stillbirth [2,37]. Our study is mostly rural. Rural communities in Ethiopia are characterized by the low literacy level. Moreover, healthcare infrastructure, availability of skilled health personnel, and distance to healthcare facilities are generally low and poor in rural areas. Furthermore, community-level literacy influences community norms, beliefs, and practices surrounding childbirth and pregnancy care, which in turn shapes maternal behaviors and influences prenatal care utilization [38]. In essence, higher literacy levels in communities contribute to a more informed and empowered population, capable of making better choices regarding their health, accessing healthcare effectively, and advocating for better healthcare services. This collective empowerment ultimately leads to a significant reduction in stillbirth rates.

In recent study, a one-year increase in women's age at first pregnancy decreased the likelihood of stillbirth by 16%. This in line with other study finding from Ethiopia [39], and from a population-based pregnancy outcome registry from 2010 to 2016 [3]. The possible scientific justification is increasing maternal age may evolve women in educational attainment from the previous pregnancy, maintaining stable relationships, attaining physical maturity, addressing pre-existing conditions, greater planning and preparation, and reduced risks associated with teenage pregnancy play a substantial role in reduction of likelihood of stillbirth. On other hand, advanced maternal age is also closely related with still birth and other age-related risks [3]. As a solution, delaying first birth and avoiding pregnancy at advanced age (i.e. mid-fertile age pregnancy) with a careful monitoring individual medical condition (regardless of age) is a highly advisable.

Our study claimed that one-child increase in women's childbirths led to 33% increase in the likelihood of stillbirth. This study finding is supported by the population-based pregnancy outcome registry, 2010 to 2016 [3], and systematic review in Sub-Saharan Africa [40]. This could be due to repeated pregnancies and birth can increase the risk of stillbirth due to factors like cumulative wear and tear, increased medical complications, maternal exhaustion, inadequate spacing between pregnancies, and underlying health conditions [3,40]. In our study, about one in five women had given birth more than four times indicating that there is a high parity in the study areas like other part of the country. High parity with advanced maternal age pregnancies strongly rise the magnitude of the stillbirth. Moreover, it may affect overall wellbeing of the mother, hence, appropriate intervention from the expected body is needed to lower the parity.

As strength, our study provided good evidences because the study involved a large representative of the study subjects (sample size) involving wide areas region with community based primary data which is very reliable. Using a multi-level mixed effect negative binomial analysis was essential for accurately modeling count data with hierarchical structures, addressing overdispersion, and providing insights that can inform practice and policy. We recommend future investigators to conduct randomized controlled trial in this area of the study.

5. Abbreviation and Synonyms

AIC……. Akaike Information Criterion

AORs……Adjusted Odds Ratios

ANC……Antenatal Care

BIC……. Bayesian Information Criterion

ICC……. Intraclass Correlation Coefficient

MHS……Maternal Health Services

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MOR……Median Odds Ratio

LMICs……. Low-Middle Income Countries

PNC……. Postnatal Care

WHO……World Health Organization

WRA……....Women of Reproductive Age

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