# Individual and Community-Level Determinants of Knowledge of Obstetric Danger Signs among Women in Southern Ethiopia: A Multi-Level Mixed Effect Negative Binomial Analysis

Amanuel Yoseph *, Yilkal Simachew, Berhan Tsegaye, Asfaw Borsamo, Yohans Seifu, Mehretu Mehretu

Posted Date: 17 September 2024

doi: 10.20944/preprints202409.1315.v1

Keywords: obstetrics; knowledge; pregnancy; information; awareness; danger sign; multilevel analysis; negative binomial regression

 doi:10.20944/preprints202409.1315.v1



*Article*

# Individual and Community-Level Determinants of Knowledge of Obstetric Danger Signs among Women in Southern Ethiopia: A Multi-Level Mixed Effect Negative Binomial Analysis

**Amanuel Yoseph [1,*], Yilkal Simachew [1], Berhan Tsegaye [2], Asfaw Borsamo [3], Yohans Seifu [1] and Mehretu Belayneh [1]**

[1] School of Public Health, College of Medicine and Health Sciences, Hawassa University, Hawassa, Ethiopia
[2] Department of Midwifery, College of Medicine and Health Sciences, Hawassa University, Hawassa, Ethiopia
[3] Department of Anatomy, College of Medicine and Health Sciences, Hawassa University, Hawassa, Ethiopia
* Correspondence: amanuelyoseph45@gmail.com

**Abstract: Introduction:** One of the key strategies to achieve sustainable development goal by reduce preventable maternal deaths below 70 per 100,000 is increasing awareness about major obstetrics danger sign. Mother's awareness of obstetric danger signs in developing country is relatively low regardless of attempts trough many local and national program. It is crucial to increase women's knowledge of obstetric danger signs through education and awareness-raising efforts. Despite its importance to reduce maternal deaths, Studies are limited only to the Northern Ethiopia. **Objective:** This study aimed to assess prevalence of knowledge of obstetric danger signs and associated factors among women who delivered in the last 12 months in Sidama region, Ethiopia. **Methods:** We conducted a community-based cross-sectional study from October to November, 2022. A multi-stage sampling procedure was utilized to select study participants. A structured and pretested questionnaire was utilized to collect data. A multilevel mixed-effects negative binomial regression model was used to control effects of clusters and confounders. **Results:** Out of 1,140 study participants, only 1,130 study participants took part in the study making a response rate of 99.12%. The overall prevalence of knowledge of obstetrics danger sign was estimated as 22.3% (95%CI: 18.7, 25.9). Government employed women (AIRR = 1.37; 95% CI: 1.2, 1.6), women who had access to mass media (AIRR = 1.16; 95% CI: 1.08, 1.25), women who had received model family training (AIRR = 1.15; 95% CI: 1.1, 1.25), autonomous women (AIRR = 1.15; 95% CI: 1.04, 1.25), women who had faced health problems during pregnancy (APR = 1.21; 95% CI: 1.11, 1.32) and urban women (APR = 1.22; 95% CI: 1.09, 1.62) were factors associated positively with knowledge of obstetrics danger sign. **Conclusion:** The prevalence of knowledge of obstetrics danger sign is found to be lower compared with the national average. Residence, mass-media exposure, model family planning, problem faced during pregnancy and women autonomy are the main predictors of knowledge of obstetrics danger sign. Public health policy makers should enhance health literacy at for focused on rural community**.** Awareness creation should be improved through mass media. Health providers should educate women during maternity health services to empower women for decision making process.

**Keywords:** obstetrics; knowledge; pregnancy; information; awareness; danger sign; multilevel analysis; negative binomial regression

## Introduction

Reducing avoidable maternal deaths to less than 70 per 100,000 live births and neonatal mortality rates to 12 per 1000 live births is the third Sustainable Development Goal (SDG) for 2030 [1]. The degree to which a pregnant woman is able to apply her understanding of the signs and symptoms of potential issues during pregnancy, labor, and the postpartum period is known as the "integrity of knowledge," which includes other people's awareness of obstetric risk signs. [2–4]. Despite numerous local and national program endeavours, mothers in underdeveloped countries are not

 doi:10.20944/preprints202409.1315.v1



often aware of the warning indications of pregnancy [5–7]. It is imperative to raise pregnant women's understanding of obstetric hazard indications through campaigns of education and awareness-building [8–10].

The World Health Organization (WHO) estimates that over 30 million women in underdeveloped nations experience severe obstetric problems annually as a result of receiving subpar or unsuitable treatment throughout pregnancy, childbirth, and the crucial first few hours following delivery. There are direct and indirect causes of maternal fatalities. Direct obstetric complications, including infection, haemorrhage, protracted and obstructed labor, unsafe abortion, and hypertensive disorders of pregnancy, account for nearly 80% of maternal fatalities globally. Maternal mortality can also result from indirect factors such anaemia, hepatitis, diabetes, malaria, and other cardiovascular conditions that are made worse by pregnancy [11].

One way to improve the use of professional treatment anytime issues related to pregnancy are expected is to educate women about the warning signals of pregnancy [12].

Unexpected obstetric symptoms that may result in problems for the mother's health are known as obstetric risk indicators. These warning indicators can be broadly divided into three groups. The three main warning indicators of pregnancy are swollen hands and face, significant vaginal bleeding, and hazy eyesight. Severe vaginal bleeding, labor lasting more than 12 hours, seizures, and placenta retention are among the main warning indicators of risk during labor and delivery. Fever, foul-smelling vaginal discharge, and acute vaginal bleeding are the main warning indicators during the postpartum period [13].

Ethiopian research show that women's awareness of these obstetric hazard indications during pregnancy, birth, and the postpartum period is still poor in sub-Saharan African nations [14,15]. Understanding the warning indicators of pregnancy difficulties is one facet of the issue that is acknowledged at the individual, family, and community levels [16,17].

Although the majority of women have uneventful pregnancies and deliveries, all pregnancies include some risk, and 15% of pregnant women will experience an obstetrical complication that could be fatal and necessitate obstetrical treatments in order to survive [18]. Understanding the warning signals of obstetric difficulties is crucial for prompt and appropriate referral to obstetric treatment as well as early problem diagnosis [16,19].

This will contribute to the goal of lowering maternal mortality worldwide to fewer than 70 per 100,000 live births by 2030[20]. It is the crucial first move in making the right referral in a timely manner to obstetric care that is critical. Likewise, raising community knowledge of the warning signals of newborn problems is crucial for boosting infant survival rates because the majority of babies are delivered at home or are released from the hospital within the first 24 hours [13]. Ethiopian women are still not well-informed about the warning indications of pregnancy, as is the case in many poor nations [21]. The results of this study will give valuable information for developing intervention programs that will improve women's awareness of obstetric warning indicators. Therefore, the aim of this study is to identify the number of women knowledgeable about obstetrics danger sign among women who gave birth in the last 12 months in Sidama region, in 2022.

## Methods

### *Study Area*

The study was done in the Northern Zone of Sidama Region, Ethiopia. Northern zone of Sidama region consists of two urban and eight rural districts [22]. It is found 273 km south of Addis Ababa, the capital city of country. There are 162 *Kebeles* (the smallest administrative units in Ethiopia) in the zone [23].

### *Study Design and Population*

We did community-based cross-sectional study from October to November, 2022, among women of reproductive age group (WRA). All randomly selected WRA who gave live birth in the last 1 year and permanent resident of the zone were included for this study. Study participants who

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were serious illness and mental disorders during the data collection period were excluded from the study.

*Sample Size Determination*

The sample size required to estimate the ODS was computed by considering the anticipated prevalence of obstetrics danger sign knowledge (34%) according to the report of a previous study [24], a margin of error of 5%, a 95% confidence level, and a design effect of 2.0. besides, sample size was calculated for the determinants of ODS. Hence, the final sample size calculated was 1,140.

*Sampling Technique*

A multi-stage sampling method was utilized to select study participants. The first, second and third stage were a selection of districts, *kebeles* and households from the Zone using a simple random sampling procedure. Lastly, eligible women were selected from households using a simple random sampling procedure.

*Study Variables*

The outcome variable has a count response and was assessed using self-reported data from women. Maternal knowledge regarding knowledge of obstetrics danger sign was measured using the 30 questions during three phases namely antepartum (9 questions), intra-partum (12 questions), and postpartum (9 questions). The correct answers were assigned a score of 1, while the incorrect answers were assigned a score of 0. Finally, the total knowledge scores range from 0 to 30. The study respondents who spontaneously mentioned knowledge of obstetrics danger sign during each phase were considered as count responses. The details of independent variables measurement provided in Supplementary (S1) File 1.

*Data Collection Procedures*

We used a structured and pretested questionnaire to collect data and it was adapted from previous similar studies [25–27].The tool was first prepared in English and it was translated into the local language (See Supplementary File 2). The tool was pre-tested on 5% of the sample in outside study area and adjusted before the main data collection. Open Data Kit (ODK) mobile application was used to collect data and exported to Stata version 17.

*Statistical Analysis*

Descriptive analysis was used to describe important variables of this study. Summary measures like absolute frequencies, percentages and the mean with standard deviation (SD) were utilized for the descriptive measures. The wealth status of study participants was calculated by using principal component analysis (PCA) (see Supplementary File 1).

The obstetrics danger sign knowledge score is a whole number or count, based on the most current thinking in the public health discipline a standard Poisson regression model was the first choice of model or considered as a starting point while operating with count data [28]. It is a method for describing count data as a product of a set of independent variables, with the assumption that the observations are independent over time and that the mean and variance of the outcome variable are identical [29]. The assumption of equi-dispersion is the most fundamental constraint of Poisson regression. It asserts that the variance that occurs in the count response variable's distribution will be equal to its mean. If this condition is violated, the Poisson regression model's estimates remain constant but provide inaccurate parameter inferences [30]. In our case, the mean and variance were 6.06 and 16.62 for obstetrics danger sign knowledge. The data were over-dispersed as a result of the assumption was violated; hence a multilevel mixed-effect negative binomial regression model was fitted to account for between and within clusters variability [28,30].

We built a five model to consider the hierarchical nature of our data namely Model zero: an empty model; Model one: model with only individual-level predictors; Model two: model with only

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community-level predictors; Model three: model containing both individual and community-level predictors; and Model four: the model with a random coefficient. A median prevalence ratio (MPR) and ICC value was used to assess the random effect model [31]. The best-fitting model was chosen based on log-likelihood with likelihood ratio test and a significant likelihood ratio test can be a reflection of the best-fitting model [32] (see Supplementary File 1).

The existence and strength of a statistically significant association were measured using AIRRs with 95% CIs or p-value.

*Ethics Statement*

Ethical approval letter was obtained from the Institutional Review Board (IRB) of the College of Medicine and Health Sciences of Hawassa University with reference number IRB/076/15. The letter of support was obtained from Sidama Region Health Bureau and *kebele* administrators. Informed written consent was obtained from study participants before data collection and after detailed information about the purpose of the study.

## Result

*Respondent Details*

The overall response rate of this study was 99.12%. The majority of study subjects were ranged between 25-29 years old. The mean (± SD) of the age of study participants was 28.33 (± 6.26) years. Sidama ethnic group was takes largest share from study participants (92.7%). Most of (85.9%) study participants were a protestant Christian faith followers, registered in primary education (64.6%) and married (98.1%). Almost half, 51.1% of the study participants had access to at least one mass media such as television, radio, and newspapers.

*Determinants of Obstetric Danger Signs Knowledge*

The women who were government employee had 35% higher likelihoods of knowledge of obstetrics danger sign than farmer (AIRR = 1.37; 95% CI: 1.20–1.56). Women's mass media use increased the likelihoods of ODS knowledge by 1.16 times compared to women who did not use mass media (AIRR = 1.16; 95% CI: 1.08–1.25). Women who had received model family training had a 15% higher likelihood of knowledge of ODS than their counterparts (AIRR = 1.15; 95% CI: 1.1, 1.25). The likelihoods of ODS knowledge had increased by 15% for autonomous women as compared to non-autonomous (AIRR = 1.15; 95% CI: 1.04, 1.25). Women who had faced health problems during pregnancy had a higher prevalence of obstetrics danger sign knowledge than their counterparts (APR = 1.21; 95% CI: 1.11, 1.32) while urban residence increased the likelihood of ODS knowledge (APR = 1.22; 95% CI: 1.09, 1.62) as compared to the rural residence (Table 1).

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

| Variables | CIRR (95% CI) | AIRR (95% CI) |
|---|---|---|
| Individual-level determinants | | |
| **Women's education status** | | |
| Cannot read and write | 1 | 1 |
| Can read and write only (no formal education) | 0.97 (0.61, 1.02) | 0.95 (0.84, 1.08) |
| Have formal education | 1.25 (1.11, 1.39) | 1.01 (0.92, 1.09) |
| **Women's occupation status** | | |
| Housewife | 1 | 1 |
| Farmer | 0.95 (0.82, 1.11) | 0.93 (0.78, 1.12) |
| Government employee | 1.42 (1.24, 1.47) | 1.37 (1.20, 1.56)** |
| Merchant | 1.22 (1.12, 1.33) | 0.937 (0.88, 1.07) |
| **Wealth quintile** | | |
| Lowest | | 1 |
| Second | 1.09 (0.82, 1.41) | 1.02 (0.92, 1.13) |

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| | | |
|---|---|---|
| Middle | 1.93 (0.91, 2.31) | 0.90 (0.81, 1.01) |
| Fourth | 1.50 (0.44, 2.77) | 1.05 (0.94, 1.17) |
| Highest | 1.40 (0.52, 2.17) | 1.04 (0.92, 1.18) |
| **Use of mass media** | | |
| No | 1 | 1 |
| Yes | 1.31 (1.23, 1.39) | 1.16 (1.08, 1.25)** |
| **Previous history of abortion** | | |
| No | 1 | 1 |
| Yes | 1.23 (0.89, 2.10) | 0.97 (0.89, 1.06) |
| **Previous history of stillbirth** | | |
| No | 1 | 1 |
| Yes | 1.22 (0.89, 1.10) | 1.10 (0.98, 1.23) |
| **Previous history of neonatal death** | | |
| No | 1 | 1 |
| Yes | 1.31 (0.82, 1.14) | 1.01 (0.92, 1.09) |
| **Current pregnancy status** | | |
| Unplanned | 1 | 1 |
| Planned | 1.09 (1.02, 1.18) | 1.08 (0.99, 1.17) |
| **Faced health problem during pregnancy** | | |
| No | 1 | 1 |
| Yes | 1.42 (1.18, 1.99) | 1.21 (1.11, 1.32)** |
| **Faced health problem during childbirth** | | |
| No | 1 | 1 |
| Yes | 1.31 (1.17, 1.98) | 1.05 (0.95, 1.16) |
| **Woman's decision-making power** | | |
| Non-autonomous | 1 | 1 |
| Autonomous | 1.19 (1.12, 1.26) | 1.15 (1.04, 1.25)* |
| **Road access** | | |
| Inaccessible | 1 | 1 |
| Accessible | 1.22 (0.89, 1.66) | 1.02 (0.93, 1.11) |
| **Received model family training** | | |
| No | 1 | 1 |
| Yes | 1.54 (1.08, 2.21) | 1.34 (1.25, 1.46)** |
| **Cluster-level determinants** | | |
| **Place of residence** | | |
| Rural | 1 | 1 |
| Urban | 1.25 (1.11, 1.56) | 1.22 (1.09, 1.62)* |
| **Cluster-level poverty** | | |
| High | 1 | 1 |
| Low | 1.16 (0.92, 1.47) | 0.96 (0.77, 1.20) |
| **Cluster-level women literacy** | | |
| Low | 1 | 1 |
| High | 1.22 (0.89, 1.66) | 0.86 (0.59, 1.25) |

*: significant association ($p < 0.05$); **: highly significant association ($p < 0.01$); CI: confidence interval; CIRR: crude incidence rate ratio; AIRR: adjusted incidence rate ratio; 1: reference group.

*Random Effect Model of Obstetric Danger Signs Knowledge*

The multi-level mixed effect negative binomial regression model fitted better than the ordinary negative binomial regression model (p <0.001). The ICC value revealed that 11.91% of the variability in ODS knowledge were related to membership in *kebele*s. The MPR value revealed that residual heterogeneity between the housing settings when randomly selecting the two individuals in different areas was related to 1.26 times the individual likelihoods of ODS knowledge. The final model, even after adjusting for all potential attributable factors, revealed that the heterogeneity in ODS knowledge across residential areas continued to be statistically significant. Further, the effect of the women decision making power on ODS knowledge showed significant variation across the *kebeles* (variance = 0.21; 95% CI: 0.10, 3.22) (See S1).

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*Model Selection Criteria*

The model fitness evaluation test of ODS knowledge showed that the empty model was the least fit (AIC = 5839.51, BIC = 5854.59, and log-likelihood = -2916.75). However, there was significant progress in the fitness of the models, specifically in the final model (AIC = 5549.84, BIC = 57541.51, and log-likelihood = -2742.88). Therefore, the final model is best fitted as compared to the other models (See S1).

## Discussion

We have assessed the prevalence and factors associated with knowledge of obstetrics danger sign among WRA who gave birth in the past 1 year. The overall prevalence of number of women who mention obstetrics danger sign spontaneously is found to be 22.3 % (95%CI: 18.7, 25.9). This finding is lower than the national average of obstetrics danger sign [33]. Furthermore this finding is lower than the studies conducted in Aleta-wondo, Sidama (37.7%)[21]. The multi-level negative binomial regression revealed that government employee, mass media exposure, model family planning training, being autonomous, facing pregnancy complication and urban residence are factors positively associated with lower incidence rate ratio of spontaneously told number of contents of knowledge of obstetrics danger sign.

Government employed women were more likely to mention more number of components of obstetrics danger sign than farmers. This finding is similar with findings of various studies [14,34,35]. Studies conducted elsewhere revealed employment was significantly associated with knowledge of obstetric danger signs. Women's employment usually improves household income and satisfies the financial needs of women; hence, they can have access to health services, from which they obtain health-related information [36,37].

Women who had media exposure had more rates of spontaneously mentioned contents of knowledge of obstetrics danger sign [17,34,38]. This difference might be due to expansion of health education by different Medias and activities of health extension workers at community level.

Women who had model family planning training had more odds of telling more contents of ODS than their counterparts. This finding is consistent with previous studies [36,38,39]. The probable reason might be that discussing health issues with health professionals is indispensable for getting clear and updated information regarding obstetric danger signs and HEWs have frequent contacts with women which could help to acquire knowledge on obstetric danger signs.

Autonomous women were more likely to have higher odds of mentioning components of obstetrics danger sign than their counterparts. This is consistent with the previous studies [14,40,41]. This is because autonomy empowers mothers to take any action anytime on health-related matters. It is clear that mothers who have full autonomy to decide to seek care from reproductive and maternal health services are more likely to have enough information and knowledge on issues including the danger signs of pregnancy, labor and delivery, and postnatal period [42]. Urban residence is more likely exposed for knowledge of obstetrics danger sign than their counterparts. This finding is similar with previous studies [3,43,44]. Women who face obstetrics danger sign were more likely to have knowledge on danger sign than their counterparts. This finding is similar with previous studies.

**Supplementary Materials:** S1 file: Some of important details in methods and results (DOCX). S2 file: SPSS data set (CV). S3 file: English version questionnaire (DOCX).

**Author Contributions:** Conceptualization: Amanuel Yoseph, Data curation: Amanuel Yoseph, Formal analysis: Amanuel Yoseph, Investigation: Amanuel Yoseph, Methodology: Amanuel Yoseph, Project administration: Amanuel Yoseph, Resources: Amanuel Yoseph, Software: Amanuel Yoseph, Supervision: Amanuel Yoseph, Validation: Amanuel Yoseph, Yilkal Simachew, Berhan Tsegaye, Asfaw Borsamo, Yohans Seifu, Mehretu Belayneh. Visualization: Amanuel Yoseph, Yilkal Simachew, Berhan Tsegaye, Asfaw Borsamo, Yohans Seifu, Mehretu Belayneh, Writing – original draft: Amanuel Yoseph, Yilkal Simachew, Berhan Tsegaye, Asfaw Borsamo, Yohans Seifu, Mehretu Belayneh, Writing – review & editing: Amanuel Yoseph, Yilkal Simachew, Berhan Tsegaye, Asfaw Borsamo, Yohans Seifu, Mehretu Belayneh.

 doi:10.20944/preprints202409.1315.v1



**Acknowledgments:** We acknowledge Hawassa University, NORAD project and the Sidama region president office for their financial support. We are also very grateful to the study subjects, data collectors, supervisors, districts health office and administrators of *kebeles* for their contribution for the success of this study.

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