

**Effect of antenatal care and severe maternal complications on
neonatal near miss in south Ethiopia**

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**A thesis submitted in fulfilment of the requirements for the degree of Doctor of
Philosophy in Reproductive Medicine**

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Statement of originality

I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision. The thesis contains no material which has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968 and any approved embargo.

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Co-author statement

By signing below, I attest that Research Higher Degree candidate Tesfalidet Tekelab Beyene has contributed to the following published papers included in this thesis by contributing to the conception and design of the studies, designing the methodologies, developing the tools, collecting and analysing data, interpreting findings and leading the writing of the manuscripts.

1. Tekelab T, Chojenta C, Smith R, Loxton D. Factors affecting utilization of antenatal care in Ethiopia: a systematic review and meta-analysis. PLoS One. 2019;14:4. (Appendix 9)
2. Tekelab T, Chojenta C, Smith R, Loxton D. The impact of antenatal care on neonatal mortality in sub-Saharan Africa: a systematic review and meta-analysis. PLoS One. 2019;14:9. (Appendix 9)
3. Tekelab T, Chojenta C, Smith R, Loxton D. Incidence and determinants of neonatal near miss in south Ethiopia: a prospective cohort study. BMC Pregnancy and Childbirth. 2020, 20:354. (Appendix 9)

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Tesfalidet Tekelab Beyene

Dedication

To my late mother (Amharich Lafore), who lost her life because of pregnancy complications.
Thank you for sending me to school and raising me with strict life principles.

To my son Abron Tesfalidet; this thesis was the reason for my being away during the first
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List of abbreviations

AIC	Akaike's information criterion
AOR	Adjusted odds ratio
ANC	Antenatal care
CI	Confidence interval
COR	Crude odds ratio
CSA	Central Statistical Agency of Ethiopia
DGH	Durame General Hospital
EDHS	Ethiopia Demographic and Health Survey
EMDHS	Ethiopia Mini Demographic and Health Survey
ENMR	Early neonatal mortality rate
FMoH	Federal Ministry of Health
HEP	Health Extension Program
HEW	Health extension worker
HIV	Human immunodeficiency virus
HREC	Human Research Ethics Committee
HSTP	Health Sector Transformation Program
HUCSH	Hawassa University Comprehensive Specialized Hospital
ICU	Intensive care unit
LBW	Low birth weight
MDG4	Millennium Development Goal 4
MDSR	Maternal Death Surveillance and Response
MI	Mortality index
MMR	Maternal mortality ratio
MNM	Maternal near miss
MNMR	Maternal near miss ratio
NEMGH	Nigist Eleni Mohammed General Hospital
NHMRC	National Health and Medical Research Council
NNM	Neonatal near miss
NNMR	Neonatal near miss rate
NMR	Neonatal mortality rate
SDG	Sustainable Development Goals
SMO	Severe maternal outcome
SMOR	Severe maternal outcome ratio
SNO	Severe neonatal outcome
SNOR	Severe neonatal outcome rate
SNNPR	Southern Nations Nationalities and People Region
SSA	Sub-Saharan Africa
PHCU	Primary health care unit
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses

TFR	Total fertility rate
UN	United Nations
UNICEF	United Nations Children's Fund
VIF	Variance inflation factors
WDA	Women's Development Army
WHO	World Health Organization

Abstract

Introduction: The health of mothers and the development of babies are very closely related and require the same services, such as antenatal care (ANC), the presence of a skilled birth attendant, availability of emergency obstetric and newborn care, postnatal care, and family planning. Such services improve the lives of both the mother and the newborn. Recently, there has been progress in the reduction of maternal deaths in Ethiopia, which is 412 maternal deaths per 100,000 live births. For every mother who dies due to pregnancy-related causes, many others experience severe maternal complications that affect the wellbeing of the mothers and their neonates. In Ethiopia, neonatal deaths account for 44% of under-five deaths. For every neonate who dies, many others experience a ‘near miss’ event that could result in death but does not. Neonatal near miss (NNM) refers to a neonate who nearly died but survived a severe complication that occurred during the neonatal period. Assessing near miss events provides health workers with a learning opportunity to use specific evidence-based interventions to prevent and treat maternal and newborn morbidities. This thesis fills a gap in the current literature by investigating the effect of ANC and severe maternal complications on NNM in south Ethiopia, using a systematic review with meta-analysis and a facility-based prospective study.

Method: In order to determine the factors affecting utilization of ANC and its impact on neonatal mortality, systematic review and meta-analysis were conducted. To investigate the magnitude of severe maternal outcomes (SMO), quality of maternal health care, incidence and determinants of NNM, a facility based prospective study was conducted. A prospective study was conducted in three hospitals among women who presented while pregnant, during childbirth and within 42 days after delivery between 12 July and 26 November 2018. A sample of 3006 women and their neonates, who were identified from the three hospitals were included in the study. The mothers and their neonates were followed from the time of admission until the hospital discharge. The World Health Organization (WHO) maternal near miss (MNM) approach was used to assess SMO indicators and quality of maternal health care. Pragmatic, clinical and management criteria were used to determine the incidence of NNM. The data were collected through an interviewer-administered questionnaire and a medical record review. Multiple logistic regression analysis was employed to identify the distant, intermediate and proximal factors associated with NNM. The independent variables

were analysed in three hierarchical levels. Adjusted odds ratios (AORs) and 95% confidence intervals (CIs) were used to determine the strength of the associations.

Result: The systematic review and meta-analysis show that pooled prevalence of utilization of ANC in Ethiopia was 63.8%. Further, utilization of at least one ANC visit by a skilled provider during pregnancy reduces the risk of neonatal mortality by 39% in sub-Saharan African (SSA) countries. The prospective study findings demonstrate that SMO incidence ratio and NNM incidence rate were 37.5 (95 % CI = 30.6 – 44.4) and 45.1 (95% CI = 37.7–53.8) per 1000 live births, respectively. The most common cause of SMO was eclampsia (37%) followed by severe postpartum haemorrhage (33.3%). The majority of SMO cases were referred from other health facilities. The intensive care unit (ICU) admission rate was 13% for women with SMO. The hospital maternal mortality ratio (MMR) and neonatal mortality rate (NMR) were 625 per 100,000 live births and 17.4 (95% CI = 13.0–23.3) per 1000 live births, respectively. Of those newborns who experienced NNM, more than half (59.8%) the mothers were referred from other health facilities. After adjusting for potential confounders, the odds of NNM were significantly higher among neonates born to a mother with severe complications. Additionally, low family income (< USD 79 monthly) and a birth interval of less than 24 months were independently associated with NNM. ANC did not show a statistically significant association with NNM.

Conclusion and recommendation: The occurrence of SMO and NNM are lower compared to other studies which used similar criteria. Efforts are required to enable early identification and prevention of severe maternal complications, reduce inequalities by increasing women's income and promote an optimal birth interval of 24 months or above through postpartum family planning to improve newborn survival and achieve the Sustainable Development Goals (SDGs) relevant to reducing maternal and infant mortality and morbidity (3.1 and 3.2). The findings also suggest that policymakers should design and implement different strategies such as reducing delays in seeking or reaching care, use of lifesaving interventions, improving the referral system in lower health facilities which may reduce severe maternal complications from occurring in hospitals and this in turn may improve the neonatal survival. Further research is also needed to measure the burden NNM in the whole neonatal period.