

# A Mediation Analysis of Determinants of New-born Care Practices in Four Regions of Ethiopia

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## Abstract

**Background:** Despite a substantial decline in under-five mortality in Ethiopia, neonatal mortality declined steadily and the contribution of the insignificant decline of neonatal mortality to under-five mortality grew from 29.5% in 2000 to 43.3% in 2016. The slow fall of neonatal mortality implies the need for an approach that addresses the main causes of new-born deaths. The World Health Organization recommends essential new-born care practices to save new-borns from morbidity and mortality. The aim of this study was to assess determinants of new-born care practice in the four regions of Ethiopia.

**Method:** The study is part of an intervention project that attempts to investigate the impact of Optimising Health Extension Project on health service utilisation of mothers and children below the age of five years. Data for 590 births that occurred in the twelve months preceding the survey was extracted from the main study data and utilized for the present study. The outcome variable of our study is the number of new-born care practices performed by women that delivered recently. Thus, Poisson regression analysis was used, and a goodness of fit test showed that the model fits the data well. Maternal healthcare utilisation is considered as a mediating variable and a difference approach was used to test whether the effects of socio-economic and demographic variables were mediated. STATA 14 was used for data management and analysis and 5% level of significance was used to declare statistical significance.

**Results:** Clothing (88.1%) and drying (75.2%) are the most frequently accomplished thermal care practices. Cutting the cord with a clean and sharp material was practiced for 83.0% of the births. For more than two third of the births (68.5%), timely initiation of breastfeeding was performed as a new-born care practice. Immunization of the new-born for polio 0 was the least performed new-born care practice for 25.8% of the births. Maternal healthcare utilisation beyond ANC was observed to be beneficial to new-born care practice. The total effect of birth preparedness and complication readiness (0.15 (0.08, 0.22)) was split to direct and indirect effect. Both the direct (0.08 (95% CI (0.01, 0.15))) and indirect (0.07 (95% CI (0.02, 0.12))) effects were statistically significant. The predictive power of birth preparedness and complication readiness through its influence on maternal healthcare utilization accounted for 45.3% (95% CI (15.6, 75.0)) of its total effect.

**Conclusion:** New-born care practice is inadequate in general. However, birth preparedness and complication readiness have dual benefit of enhancing both maternal healthcare utilization and new-born care practices. Therefore, women shall be provided with information on benefits of facility delivery and getting professional assistance during delivery to improve new-born care practices. [*Ethiop. J. Health Dev.* 2021; 35(2):000-000]

**Keywords:** New-born care practice, mediation analysis, birth preparedness and complication readiness

## Introduction

Globally, the total number of under-five deaths dropped from 12.6 million in 1990 to 5.6 million in 2016. That means, 15,000 under-five deaths were registered every day in 2016 compared with 35,000 in 1990. Moreover, 2.6 million new-borns died in 2016 with a daily figure of 7,000 new-born deaths per day. Neonatal deaths accounted for 46 per cent of all under-five deaths in 2016, increasing from 41 per cent in 2000. Of all neonatal deaths, 36% die on their first day, 37% within the next six days of life, and 28% between day 7 and day 27 (1, 2). In 2019, four in five (80%) of neonatal mortalities occurred in low- and middle-income countries with the highest rates (27 deaths per 1,000) occurring in sub-Saharan Africa and is among the regions showing the least progress for over multiple decades (3–5).

causes of new-born deaths. Evidence suggest that the rampant preventable neonatal morbidity and mortality can be significantly averted by simple but high-impact interventions that address the needs of women and new-borns during pregnancy, delivery and postnatal periods (6,7). World Health Organization (WHO) recommends essential new-born care practices to protect new-borns from morbidity and mortality. The essential new-born care practices include all cares given to the new-born beginning immediately after birth and around the time of birth. Some of those cares include safe cord care (7,8), thermal care (7,9), initiating breastfeeding within the first hour of birth (7), and immunisation from BCG and Polio, which is the most effective preventive health measure to reduce vaccine-preventable neonatal morbidity and mortality (7,10).

The delay in the fall of neonatal mortality is indicative of a need for an approach that addresses the main

In 2015, members of the United Nations have launched a renewed effort to reduce child mortality under the

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Sustainable Development Goals (SDGs). One major target of the SDGs is to end preventable deaths of newborns and children under five years of age, with all countries aiming to reduce neonatal mortality to at least 12 per 1,000 live births and under-5 mortality to at least 25 per 1,000 live births by 2030.(11) Despite a substantial decline in under-five mortality in Ethiopia, neonatal mortality declined less substantially and its contribution to under-five mortality increased from 29.5% in 2000 to 43.3% in 2016. The leading causes of new-born deaths, which account for 80% of the deaths are asphyxia, complications of preterm birth and sepsis (12,13).

Several studies showed that unsatisfactory maternal health care practice, socio-economic, demographic, and cultural factors were among the determinants for inadequate and sub-optimal new-born care practice and causes for morbidity and mortality (4,14–17). Studies conducted on new-born care practice in Ethiopia, however, are limited in scope and type of analysis. In the present work, maternal healthcare utilisation is considered as an intervening variable in the causal pathway between distal variables and new-born care practices. It is believed that an assessment of mediated effect of a variable helps improve our understanding of the relationship between a variable and an outcome (18). Therefore, this study aimed to assess determinants of new-born care practice in four regions of Ethiopia by considering maternal healthcare utilisation as a mediating factor in wider socio-cultural and economic situations.

### Methods and Materials

**Study setting, design, and period:** Fifty-one districts selected from four regions of Ethiopia, namely, Oromia, Amhara, Tigray and Southern Nations, Nationalities and Peoples (SNNP) were used as study areas. The districts were sampled from a total of 10 Zones: two from Oromia, two from Amhara, four from Tigray, and two from SNNPR. The allocation was made based on maternal and child health indicators of each of the regional states. The current work utilised baseline data on maternal health and new-born care practices that was gathered during December 2016 - February 2017(19) via Dagu Project, an intervention project that investigated the impact of Optimizing Health Extension Project (OHEP) on the health service utilisation for mothers and children below the age of five years.

**Population:** The population for this study consisted of mothers who had a livebirth in the last 12 months before date of the survey and who were available at the household during the interview. Those who agreed to participate were included in the study.

### Sampling technique and sample size:

A two-stage stratified cluster sampling technique was applied in the selected districts. In the first stage, 200 enumeration areas (EAs) or clusters that constitute the primary sampling unit were selected with probability proportional to size from the 51 districts. In the second stage, a systematic random sampling technique was employed to select 30 households from each EA,

totalling 6,000 households. Our sampling frame for selecting the 30 households from each EA was a listing of households generated by enumerators. All women of age 15 to 49 years that were found in the selected households were included in the study. Data for all births (590 births) that occurred in the twelve months preceding the survey was extracted from the main study data and utilised for the present study.

### Measurements

**New-born care practices:** for this study, new-born care practices include thermal care, safe cord care, optimal breastfeeding, and immunisation at birth. Thermal care included indicators for immediate drying of the new-born, delayed bathing of the new-born until 24 hours after birth, skin-to-skin contact of the new-borns with their mothers, and clothing. Safe cord care comprised using clean instrument to cut umbilical cord and with no substance applied on it. Optimal breastfeeding referred to initiation of breastfeeding within the first hour of delivery and no additional feeding given and immunisation denoted Polio vaccination of the new-born at birth.

Maternal healthcare utilisation is the mediating variable of the present study. Seven indicator variables were used to construct maternal healthcare utilisation. The items were at least one antenatal care (ANC) attendance at health facility, antenatal care visits of 4+, delivery at health facility, professional assistance at delivery, and attendance of postnatal care measured using visit on first day or first week or late beyond the first week of birth. A latent class analysis was used to construct a five-category ordinal latent variable that measures maternal healthcare utilisation from the indicators. The categories of the latent variable range from poor to best utilisation of maternal healthcare.

Combinations of socio-demographic and socioeconomic variables were considered as predictor variables for predicting new-born care practices. In the list of socio-demographic variables, marital status (Currently in union/Not in union), family size (Small [ $\leq 4$ ]/Medium [5–6]/Large [ $> 6$ ]), parity ([ $< 4$ ]/ [4–7]/ [8+]), and age of the mother at delivery ([15–24]/ [25–34]/ [35+]) were included. Among potential socioeconomic and cultural determinant variables, maternal educational achievement (Illiterate/Primary/Secondary+), household relative wealth index, administrative region and religion of the mother were considered.

Other determinants such as knowledge on obstetric danger signs and birth preparedness and complication readiness were also considered in the analysis. Mothers' knowledge on obstetric danger signs—were given scores based on their awareness of danger signs on the following 10 items: severe headache, blurry vision, reduced or absent foetal movement, high blood pressure, oedema of the face/hands, convulsions, excessive vaginal bleeding, severe lower abdominal pain, fever, and anaemia. The scores thereafter were classified to categories as those having poor knowledge (score less than or equal to 2 and coded as 1) and average level of knowledge (score 3-6 and coded as 0).

Birth Preparedness and Complication Readiness (BPCR): scores of mothers based on their response to preparation on financial, transport, food, identification of birth attendant, and identification of facility were used to measure BPCR. Accordingly, mothers who fulfilled at least 3 of the 5 items were considered as 'well prepared' which is coded as 1 and otherwise 'not well prepared' and coded as 0.

#### **Data collection and processing**

Data was gathered using a structured questionnaire that was first prepared in English language and then translated in local languages: Afaan Oromo, Amharic, and Tigrigna. CSPro software was used to design a computer-assisted personal interview (CAPI) tool and tablets were used to gather the information from field. Internet file streaming system (IFSS) was used to sync data from the tablets to a central server using a 3G modem. One advantage of using CAPI is that it helps to ensure data quality by keeping the sequence and checking the logical consistency of the data collected. Using CAPI also saves time of data processing as data are entered during field interview. Finally, the collected data was exported to STATA version 14 for further processing and analysis.

#### **Data quality assurance**

Data collectors who had at least a first degree in health were recruited. Health Officers trained in integrated community case management and community-based new-born care were employed as team leaders. Each data collection team had two enumerators, one health examination observer and re-examiner and a team leader. A 10-days training on the purpose of the survey and the contents of the questionnaire and techniques of interviewing was given to the data collection teams. The questionnaires were pretested. During the fieldwork, the supervisors carried out at least two re-interviews per cluster to check the quality of the interviews and observed each interviewer in their respective team during each day of data collection. These re-interviews and observations were used as a means of providing feedback to interviewers, ensuring consistency between interviewers, and continuously improving the quality of the work.

#### **Ethical considerations**

Verbal consent was obtained from all participants of the study. Ethical approval was obtained from Jimma

University Faculty of Public Health. Ethical approval was also secured from the Ethiopian Public Health Institute and Regional Health Bureaus in Amhara, Oromia, SNNP, and Tigray regions.

#### **Data analysis**

The outcome variable for this study was the number of new-born care practiced by women that delivered in the 12 months preceding the survey. Poisson regression analysis was used, and a goodness of fit test showed that the model fits the data well. In our analysis, maternal healthcare utilisation is considered as a mediating variable, a variable that was related to both the outcome variable and some of the proposed predictor variables. A difference approach was used to test whether the effects of predictor variables were mediated by maternal healthcare utilisation. Initially, the total effect of variables was evaluated in a model that did not include the mediator variable. In a follow up, the direct effect of variables was estimated in the presence of a mediating variable in the model. Finally, the difference in coefficients between the two models was produced to estimate the mediated effect of a variable (20). Variables whose total effects were statistically significant or variables that have an at least partially mediated effect were included in the final model. Generalised structural equation model was employed for the mediation analysis. STATA 14 was used for data management and analysis and 5.0% level of significance was used to declare statistical significance.

#### **Results**

**Background characteristics:** An almost equal proportion of male (50.4%) and female (49.6%) births were observed. For a quarter of the births (25.9%), the mothers did not attend antenatal care for the index baby; for half (51.0%) of the index births, the mothers started attending ANC at the appropriate time. Institutional delivery is less common (44.9%) and less than half of the births (47.3%) were assisted by a health professional during delivery. Postnatal care was entirely absent for most of the births (80.7%) and only a handful (6.8%) of the index births had a postnatal check-up within 24 hours. For the remaining index births, the postnatal check-up was either late (4.5%) or happened in the first week after birth of the baby (8.0%) (Table 1).

**Table 1: Selected characteristics of births in four regions of Ethiopia, December 2016 to February 2017**

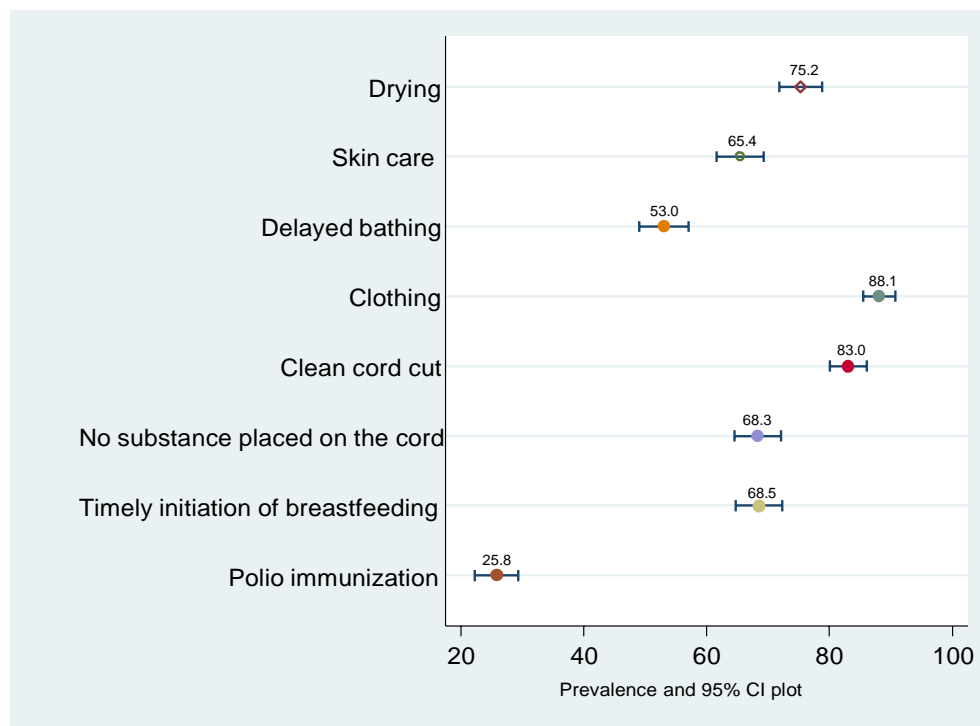
Characteristics and categories	No.	Per cent
<b>Sex of the baby*</b>		
Male	293	50.4
Female	288	49.6
<b>ANC (Timing)</b>		
No	153	25.9
First trimester	301	51.0
> First trimester	136	23.1
<b>Institutional delivery</b>		
Assisted delivery	265	44.9
<b>Postnatal care</b>		
No	476	80.7
Within 24 Hours	40	6.8
1-6 days	47	8.0
Late	27	4.5
<b>Total</b>	<b>590</b>	<b>100.0</b>

\* 9 Missing observations on sex of the new-born

### New-born care practices

Clothing (88.1%) and drying (75.2%) were the most frequently accomplished thermal care practices. Skin care (65.4%) and delayed bathing (53.0%) were also thermal care practices performed with a medium magnitude. Cutting the cord with a clean and sharp material was practiced for 83.0% of the births. While

this is a promising practice, substance was placed on the chord in more than three in ten of the births (31.7%). For more than two-thirds (68.5%) of the births, timely initiation of breastfeeding was performed as a new-born care practice. Immunisation of the new-born for polio 0 was the least performed new-born care practice (25.8%). (Figure 1).



**Figure 1: New-born care practices: Prevalence and 95% Confidence Interval Plot in four regions of Ethiopia, December 2016 to February 2017**

Only 6.3% of the mothers practiced all the new-born care practices. On the other hand, more than a quarter (27.7%) of the mothers practiced inadequate number (less than five) of new-born care practices. It was also observed that most mothers practiced five to seven new-born practices (65.9%) (Figure 2). The

average number of new-born care practices was similar across the four regional states. It was also observed that the practice did not show variability by many other maternal characteristics such as religion, knowledge of danger signs, family size, and marital status of mothers (Table2).

Table 2: Mediation Analysis Using the Difference Approach, Result from Generalized Structural Equation Model plot of mothers in four regions of Ethiopia, December 2016 to February 2017

Characteristics and categories		No.	Mean Number of Practices	Total Effect (TE) Coef [95%CI]	Direct Effect (DE) Coef [95%CI]	Indirect Effect (IE) Coef [95%CI]	Ratio of IE to TE (95%CI)
Region	Amhara [ref]	153	5.2	0.00			
	Oromia	303	5.4	0.05 [-0.03,0.12]			
	SNNPR	77	5.2	-0.01 [-0.12,0.09]			
	Tigray	57	5.0	-0.06 [-0.17,0.06]			
Religion	Christians [ref]	389	5.3	0.00			
	Other	201	5.3	-0.01 [-0.08,0.05]			
Age	15-24 [ref]	202	5.4	0.00	0.00		
	25-34	313	5.3	-0.01 [-0.07,0.05]	-0.01 [-0.07,0.04]		
	35+	75	4.6	-0.11 [-0.23,0.01]	-0.12 [-0.22, -0.01]		
Parity	<4 [ref]	330	5.4	0.00			
	4-7	219	5.2	0.04 [-0.04,0.11]			
	8+	39	4.5	-0.08 [-0.26,0.09]			
Family size	Small [ref]	220	5.5	0.00			
	Medium	194	5.2	-0.05 [-0.12,0.02]			
	Large	176	5.1	-0.01 [-0.11,0.08]			
Maternal education	No education [ref]	326	5.1	0.00	0.00		
	Primary	205	5.4	0.03 [-0.02,0.09]	0.05 [0.00,0.10]		
	Secondary+	59	5.8	0.09 [0.00,0.18]	0.08 [-0.01,0.17]		
Marital status	In union	566	5.3	-0.06 [-0.17,0.04]			
	Not in union [ref]	20	5.6	0.00			
Socio-economic quintile	Lowest	123	5.1	-0.05 [-0.13,0.02]	-0.02 [-0.10,0.05]		
	Second	113	5.0	-0.09 [-0.18,0.00]	-0.09 [-0.18,-0.01]		
	Middle [ref]	116	5.4	0.00	0.00		
	Fourth	112	5.6	0.02 [-0.06,0.10]	0.00 [-0.08,0.07]		
	Highest	126	5.4	-0.05 [-0.13, 0.03]	-0.08 [-0.16, -0.01]		
Knowledge of danger signs	Average [ref]	150	5.4	0.00			
	Poor	440	5.2	-0.01 [-0.07,0.05]			
BPCR	Not Well prepared [ref]	453	5.2	0.00	0.00		
	Well prepared	137	6.1	0.15 [0.08,0.22]	0.08 [0.01,0.15]	0.07 [0.02,0.12]	45.3 (15.6, 75.0)
Maternal Healthcare Utilisation	None [ref]	259	4.8		0.00		
	Only ANC	56	5.1		0.04 [-0.03,0.12]		
	<4 ANC & DC	144	5.8		0.18 [0.12,0.25]		
	4+ ANC & DC	95	5.9		0.15 [0.08,0.22]		
	ANC, DC & PNC	36	5.5		0.12 [-0.01,0.24]		

ref= Reference Category

Coef= Coefficient of Poisson Regression

CI=Confidence Interval

Two maternal characteristics, maternal healthcare utilisation and birth preparedness and complication readiness, had a notable relationship with the average number of new-born care practices. The average number of practices was higher for mothers that were attending at least both ANC and DC (about 6) as

opposed to those that were having only ANC attendance (average of 5). Furthermore, the average number of new-born care practice was higher among women who were well prepared for birth and its complication (6.1) as compared to among mothers that were not well prepared (5.2) (Figure 2).

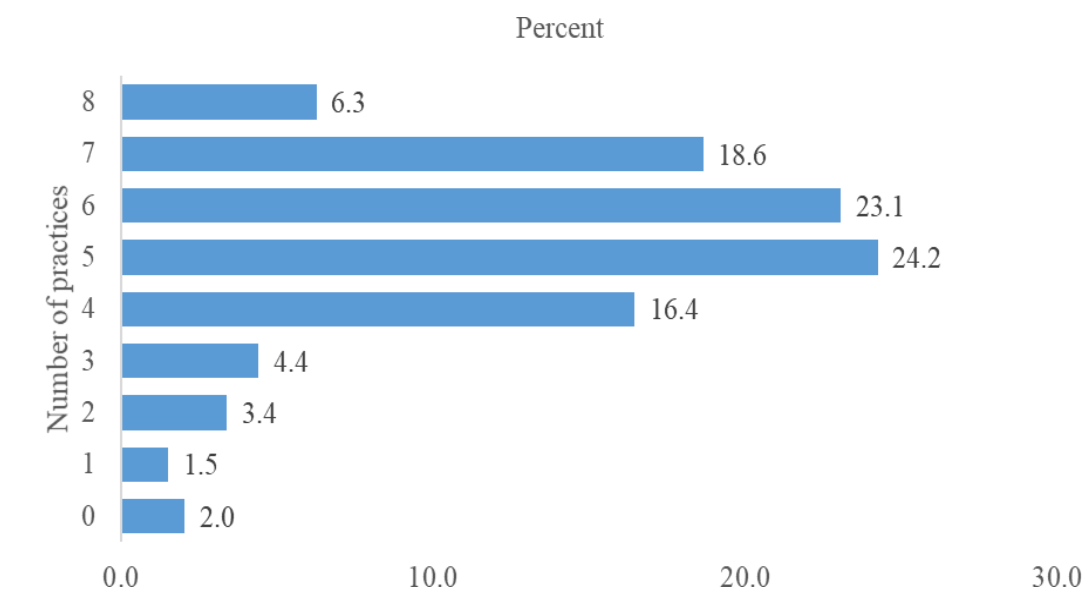


Figure 2: Number of new-born care practices Plot in four regions of Ethiopia, December 2016 to February 2017

#### Multivariable analysis

A multivariate mediation analysis was carried out using generalised structural equation model having a Poisson distribution family and a logarithm link function. As such, many of the background variables did not have a statistically significant total effect, which is effect of a variable on the outcome in the absence of the mediator. Thus, these variables were removed from the mediation analysis and both the direct and indirect effects of these variables were not determined. Even though some variables lack a statistical significance, there were instances where their categories were significant and such variables including age and educational status of the mother and household's socio-economic status were considered in the mediation analysis.

Region of residence, religion, parity, family size, marital status, and knowledge of danger signs did not significantly predict the mean number of new-born care practices. The findings of maternal education were marginally insignificant, showing that women of secondary and above level of education had an 8% increased chance of a greater number of new-born care practices as compared to women who were not able to read and write (0.08 [-0.01,0.17]). On the other hand, older women (aged 35+ years) had a 12% reduced chance of practicing a higher number of new-born care practices (-0.12 [-0.22, -0.01]) than younger women (aged 15-24). Women residing in poor and the richest households were 9% (-0.09 [-0.18, -0.01]) and 8% (-0.16, -0.01]) less likely to have had a larger number of new-born care practices, respectively, as opposed to women residing in middle socio-economic status households. These characteristics were seen to

have only a direct effect and the indirect effect was entirely absent (Table 2).

Maternal healthcare utilisation was another factor that played a role in predicting new-born care practices in the study area. As shown in Table 2, no difference in new-born care practice was observed between women that had only a single ANC visit and women that did not have any visit of a health facility during the pregnancy of the index child. Maternal healthcare utilisation beyond ANC was observed to be beneficial to new-born care practice. The finding for utilisation of all maternal healthcare services was only marginally significant. That suggests that well prepared women for birth and related complication during pregnancy of the index child were advantaged in increased new-born care practice as compared to less prepared women; the total effect was 0.15 (95% CI [0.08,0.22]). This corresponds to a 16.2% increase in the likelihood of having a higher mean number of new-born care practices (Table 2).

Of all the background variables, only the influence of birth preparedness and complication readiness was mediated by maternal healthcare utilisation. The total effect of BPCR was split to direct and indirect effect and both the direct (0.08 (95% CI (0.01, 0.15))) and indirect (0.07 (95% CI (0.02, 0.12))) effects of BPCR were statistically significant. The indirect effect, that is, the predictive power of BPCR through its influence on maternal healthcare utilisation, accounted for 45.3% (95% CI (15.6, 75.0)) of its total effect. This indicates the fact that the influence of BPCR was partially

mediated by its positive influence on maternal healthcare utilisation (Table 2).

### Discussion

The aim of the study was to assess the level and determinants of new-born care practices in four regions of Ethiopia. The data analysis approach employed for the study was different from previous studies in that maternal healthcare utilisation was used as a mediator variable for socio-economic and demographic characteristics of mothers, danger sign and BPCR. Good new-born care practices are helpful strategies to improving child health outcome. Among the recommended new-born care practices considered in the present study, polio immunisation coverage had the most discouraging performance whereas safe cord care and clothing were practiced by most of the mothers. It should be noted that more than half (55.1%) of the mothers gave birth outside a health facility, and this could be a reason for the under-performance of polio 0 vaccination coverage. Besides, this low coverage could be attributed to shortage of polio 0 vaccine in hard-to-reach rural areas of the country, power interruption and lack of transportation from health posts to health centres where vaccines are usually stored.

The overall performance of good new-born care practice (6.3%) was lower than the prevalence reported by previous studies conducted in Southwest Ethiopia (59.5%), Gedeo (24.1%), and Tigray (26.7%) (14,21,22). While the study from Tigray was a facility-based study, the report from Gedeo Zone and Southwest Ethiopia used varied techniques of measurement for new-born care practice having an arbitrarily chosen to cut off value for defining good practice. The variance in the prevalence could be explained by the differences in the definition of population and techniques of measurement employed between our study and previous reports. The low level of new-born care practice in our study is attributed to absence of polio immunisation at birth, bathing of the new-born earlier than recommended, postponement of breastfeeding to later than an hour after birth and placing substance on the cord.

Maternal healthcare utilisation was an intervening variable that was found to have a positive influence on new-born care practice. We have noticed that ANC alone was not sufficient to encourage mothers to perform new-born care beyond the average practice. Rather, it is maternal healthcare service utilisation beyond ANC that positively and significantly predicted new-born care practice. Contrary to our report, studies from Tigray Region, Gedeo Zone, and Chench District of Ethiopia reported that ANC follow up during pregnancy of the index birth significantly predicted new-born care practice (21,23–25). Whereas, a study from Ghana reported a mixed finding, indicating that ANC attendance positively predicted thermal care, cord care and neonate nutrition separately but not the overall new-born care practice(26). Given the difference in the measurement of maternal healthcare service utilisation between our study and this research, our finding suggests that women that delivered at health facility adopt an optimal number of

new-born care practices by default due to the interaction they may have with health professionals.

A finding from a recent study conducted in semi-urban Ethiopia revealed the positive influence of BPCR on uptake of delivery care. Well prepared women were more than three times likely to deliver at facility than less prepared women (27). A study from hard-to-reach areas of Bangladesh also reported that well-prepared women were more likely to deliver at a health facility and practice clean cord care (28). To the best of our knowledge, there is scarcity of published studies focusing on the mediated effects of BPCR on new-born care practices. In the present research, however, the significant total effect of BPCR was partially mediated by maternal healthcare service utilisation verifying the dual gain of BPCR. First, it positively affected maternal healthcare service utilisation, allowing the benefit to new-born care practice of women through an improved maternal healthcare utilisation. Second, BPCR by itself is capable of directly influencing neonatal care practice of women.

There was no significant variability in the average number of new-born care practices across regions. Another contribution of the present work is the revelation that the practice was found to be similar in different cultural contexts. Maternal educational status was also observed to have null effect on the outcome of the study. Consistent with our finding, some studies reported null finding of maternal education (26,28); whereas, a study from Gedeo zone of Ethiopia reported an increased likelihood of good neonatal practice for mothers that attended formal education (21). Educated women are more likely to utilize beneficial maternal healthcare services.

In conclusion, new-born care practice in the present study was extremely low. Absence of immunisation at birth, placing substance on the cord, and bathing of the new-born were practiced, leaving the overall practice at sub-optimal level. The inadequate practice of the practices is highly likely to cause harm to the new-born and lead to morbidity and mortality. Information provision to women regarding BPCR and danger signs, was also inadequate. Therefore, given the dual benefit of BPCR, adequate advice shall be provided to women during pregnancy about BPCR.

### Competing interests

The authors declare no conflict of interest.

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### Authors' contributions

AH: Conceptualised and formulated the research idea, aim and design and was the main contributor in drafting the literature review, statistical analysis, writing, interpretation, and discussion as well as conclusion of the study.

GT: Contributed to conceptualising the design of the study and editing of the manuscript.

LS: Contributed to conceptualising the design of the study and editing of the manuscript.

YO: Contributed to conceptualising the design of the study and editing of the manuscript.

All authors read and approved the final manuscript.

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