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Enhancing pastoralist women's knowledge of danger signs through home-based life-saving skills intervention in Northern Kenya: A quasi experimental study

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ABSTRACT

Background: Maternal recognition of obstetric danger signs is crucial for reducing maternal mortality and delays in seeking emergency care. However, there is insufficient knowledge about obstetric danger signs among women in rural Kenya, especially in the hard-to-reach pastoralist communities. This study aimed to determine whether home-based life-saving skills intervention improves knowledge about obstetric danger signs among women in Marsabit County, Kenya.

Methods: We conducted a quasi-experimental study with pre-posttests among 256 pregnant women, allocated to intervention and control groups. We implemented sensitization of pregnant women on obstetric danger signs and basic life-saving actions as components of home-based life-saving skills intervention. While the control group continued with routine services. Descriptive statistics was used to analyze demographic data. The chi-square test and Difference-in-Difference analysis were used to compare the intervention's proportion differences and net effect.

Results: At baseline, no significant differences in the knowledge level existed. Proportions of women who were knowledgeable of >3 danger signs increased significantly during pregnancy [(89.7%) vs. (62.5%), $p < .0001$], birth [(86.5%) vs. (75.0%), $p = .022$], postpartum [(92.1%) vs. (74.2%), $p < .000$] and neonatal period [(96.8%) vs. (66.7%), $p < .0001$] in the intervention group than the control group at end-line.

Conclusion: These results imply that it is possible to improve knowledge of obstetric danger signs among women from hard-to-reach pastoralist communities as part of home-based life-saving skills interventions. Our work contributes to the United Nation's sustainable development goal 3, which focuses on equity and commitment to reaching people needing health services regardless of where they live and their circumstances.

1. Introduction

Maternal mortality remains unacceptably high globally despite the progress made over the years. Approximately 295,000 deaths occurred among women during pregnancy and childbirth in 2017.[1] 94% of these deaths occurred in resource-constrained settings.[2] The maternal death rate estimates in developing countries stand at 216 deaths per 100,000 live births, which is very high compared to 12 deaths per 100,000 live births in developed countries.[3,4]

Approximately two-thirds (n = 196,000) and roughly one-fifth (n = 58,000) of worldwide maternal deaths in 2017 were from sub-Saharan Africa and Southern Asia, respectively.[1] In Kenya, neonatal deaths account for 66% of infant deaths and 51% of children under five years deaths.[5] However, considerable disparities in maternal and neonatal mortalities exist among 47 counties in Kenya, with the hard-to-reach arid and semi-arid counties having the highest burden of these deaths.

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Reducing maternal mortality in the regions with the highest burden requires addressing preventable causes and heightened quality of individual-based care.[2,6] However, studies show that there is limited health system capacity in developing countries to provide emergency obstetric care, contributing to the overall high maternal death rates.[4,7] Novel strategies that complement existing country-level efforts are required to achieve the Sustainable Development Goal (SDG) 3.[1,4]

Improving women's knowledge of danger signs is a crucial step in reducing maternal and neonatal mortality. This enhances women's ability to recognize danger signs during pregnancy, childbirth, and postnatal periods and take early action.[8] Since obstetric complications are unpredictable, it is imperative that all women are aware of these danger signs in order to seek appropriate healthcare services,[9] which could minimize maternal mortality.[7,8,10] When combined with other efforts, this initiative could eventually contribute to the United Nations' global goal 3.1 of reducing maternal mortality to below 70 per 100,000 live births by 2030.[11]

Although several hospital-based studies on awareness of maternal danger signs have been done in different parts of the world,[2,8,12,13] women from hard-to-reach pastoralist communities are uniquely different from the rest of the general population; hence, these studies' findings might not apply to them. Due to socioeconomic marginalization among pastoralist communities, women give birth at home, aided by traditional birth attendants, unlike the rest of the population.[14,15] In addition, there is poor accessibility and low utilization of maternal and child health care services among these communities, thus contributing to high maternal deaths.[15]

One of the strategies to address high maternal and newborn deaths among rural populations is community-based interventions, particularly the innovative approaches of the home-based life-saving skills (HBLSS) program. HBLSS is a family-focused, community-based intervention to reduce maternal and newborn deaths developed by the American College of Nurse-Midwives.[16] This intervention teaches pregnant women to recognize danger signs and promote health-seeking behavior. In this study, we adapted the intervention to the local context by first training community health volunteers who were used to implement the intervention at the community level by training pregnant women.

While healthcare professionals usually offer health education about obstetric danger signs during antenatal care (ANC) visits in health facility settings, Marsabit County, located in northern Kenya, still records a low ANC coverage of 67%, compared to urban settings with 99%.[5] This implies that a substantial number of women miss maternal health education in this county, requiring public health to examine different approaches, such as HBLSS, that could help deliver health messages at the community level to improve pregnancy and birth outcomes. Here, we designed and implemented a quasi-experimental study to assess the effect of HBLSS intervention on the knowledge of maternal and neonatal danger signs among women from hard-to-reach pastoral communities in Marsabit County.

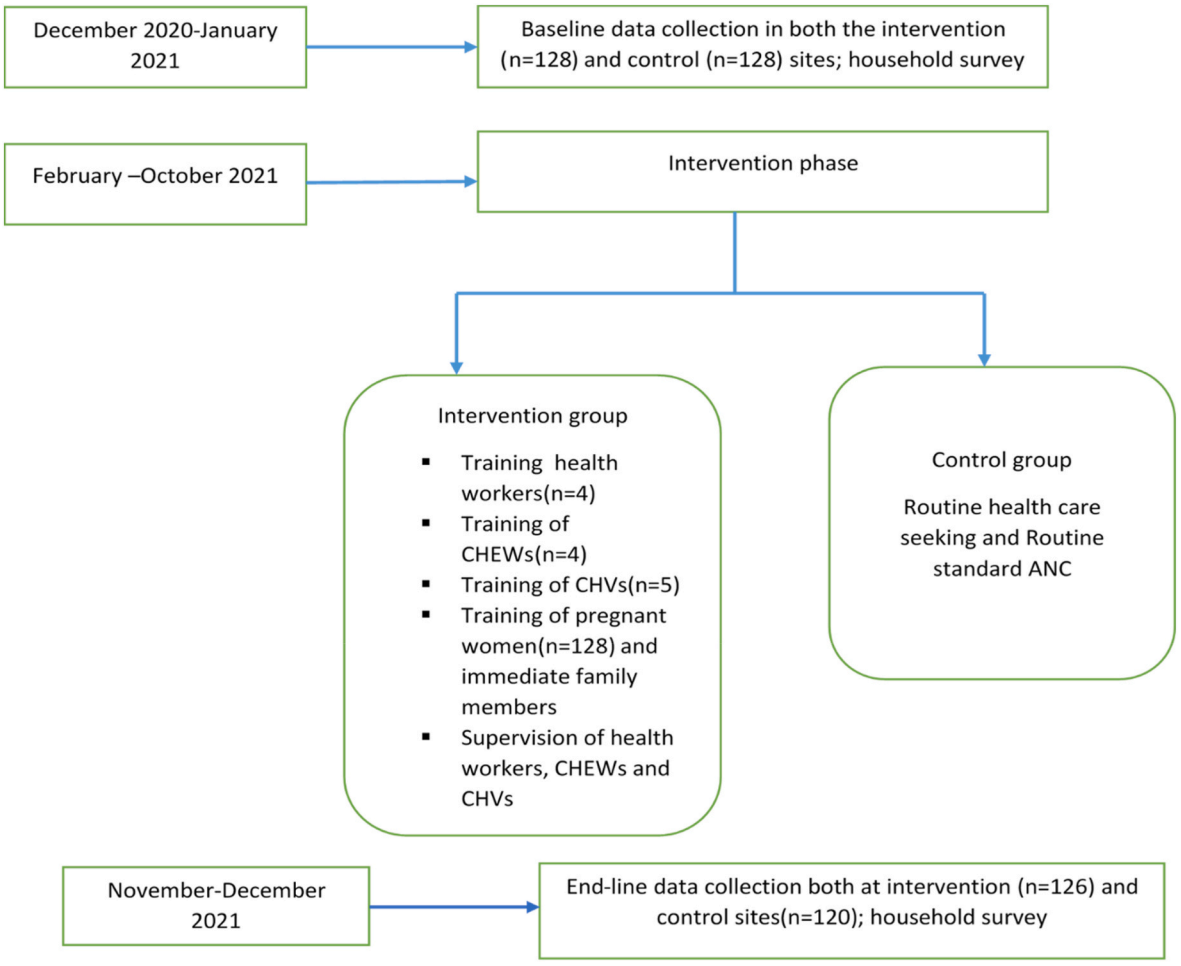

Fig. 1. Study and data collection phases
CHEW, Community Health Extension Worker; CHVs, Community Health Volunteers; ANC, Antenatal Care.

2. Materials and methods

2.1. Study design and timeline

This study adopted a pre-and post-test quasi-experimental study with intervention and control arms. We collected baseline survey data among pregnant women of reproductive age in their first trimester between December 2020 and January 2021. Likewise, after nine months of implementation of home-based life-saving skills intervention, we conducted an end-line survey between November and December 2021 (Fig. 1).

2.2. Study setting

The study was conducted in the villages of Marsabit County. Marsabit County is one of Kenya's marginalized, hard-to-reach, arid, and semi-arid counties. The residents mainly practice agro-pastoralism. Additionally, major maternal health indicators of this County fall below the national average. Marsabit County is one of 15 counties in Kenya that account for more than 60% of maternal deaths.[5]

2.3. Study participants

This study included all pregnant women of reproductive age who were in their first trimester ≤16 gestation weeks and resided in the two arms of the study areas. We excluded severely ill women and those who did not consent to participate.

2.4. Sample size and sampling technique

This study calculated the pre and post-intervention study sample size using Fleiss' formula for two proportions. We based the calculation on the following assumptions: that the intervention would increase facility delivery by 50% from the reported 25% by Kenya Demographic Health Survey (KDHS) 2014 in the County; a power of 80%, a two-sided significance level of 95%, and two equal groups, considering a maximum design effect of 2. This yielded a sample size of $(58 \times 2) = 116$. We added 10% of the 116 to account for the attrition rate, generating 128 women each for the intervention and control arms. Consequently, we recruited 256 pregnant women in the baseline survey and 246 women (intervention arm = 126 and control arm = 120) in the end-line survey. This study in Marsabit County, Kenya, randomly selected two (Sololo and Uran) out of the four sub-counties. Sololo was purposively selected as the intervention site based on poor maternal health indicators, while Uran was chosen as the control site located 30 km from Sololo to avoid contamination. We selected study participants from household registers using purposive sampling based on the eligibility criteria. Community health volunteers (CHVs) visited and interviewed the selected the women for possible signs of pregnancy, and confirmed using a self-pregnancy test. After that, well-trained research assistants collected data using interviewer-administered semi-structured questionnaires.

2.5. Intervention

Our intervention included Home-based Life-Saving Skills (HBLSS) adapted from American College of Nurse-Midwives modules and proven to be effective in Ethiopia, Tanzania, Liberia, and other African countries. A home-based life-saving skills intervention is a specific initiative aimed at improving the understanding of pregnant women about the early warning signs and symptoms of obstetric complications during pregnancy, childbirth, and the postpartum period. This type of intervention equips women with the knowledge and skills to recognize key danger signs, empowering them to seek timely and appropriate medical care to mitigate the associated risks. Eventually, contributing to the goal of reducing maternal and neonatal mortalities.

Home-based life-saving skills intervention involve health education component, where women are sensitized on recognition of danger signs such as severe bleeding, high fever, severe abdominal pain, and other indicators that might suggest complications, and encouraged to take prompt action. These programs can be an important component of broader efforts to improve maternal and child health, especially in resource-constrained settings.

The HBLSS training module covered neonatal and maternal danger signs and the initial actions to respond to an obstetric complication. The principal investigator; a registered nurse with a clear understanding of HBLSS modules, trained five community health volunteers (CHVs), four community health extension workers (CHEWs), and healthcare workers at the intervention site for two weeks.

The trained CHVs conducted four home visits in the first, second, and third trimesters of pregnancy and one within two weeks after delivery, supervised by the trained healthcare providers. In the first home visit, the CHVs introduced HBLSS core topics, sensitizing them on danger signs during pregnancy and recommended responses. In the subsequent visits, they discussed danger signs during childbirth, postpartum, and neonatal period, respectively and life-saving actions to be taken in case obstetric complication occurs. The control group continued with their routine maternal and neonatal health care services.

2.6. Ethical consideration

The study was approved by the Institutional Research and Ethical Committee of the University of Nairobi-Kenyatta National Hospital (ethical approval number P825/12/2018); the National Commission for Science, Technology, and Innovation (NACOSTI) issued the research permit, and we also sought permission from the offices of Marsabit County and sub-County commissioner. In addition, the area's local leaders and sub-county public health officers were informed of the study. Finally, written informed consent was obtained from study participants and/or their legal guardians for the participants below 16 years of age for study participation and publication of the study findings. We also adhered to the relevant guidelines and regulations in the Declaration of Helsinki.

2.7. Data analysis

The collected data were cleaned in MS Excel and exported into SPSS (Version 26.1), IBM. Categorical data were presented as frequencies and relative frequency. Cross-tabulation estimated the proportion of women within the categorical variables. A Chi-square test was employed to compare the sociodemographic characteristics of participants at baseline and end-line. Maternal danger signs knowledge z scores were computed, and the knowledge scores were categorized into low and high knowledge levels. Those who mentioned at least three danger signs during the neonatal period, pregnancy, birth, and after delivery were considered to have a high knowledge level. On the other hand, those who could not mention three danger signs in each set of these signs were supposed to have a low knowledge level. This type of knowledge score categorization have been used by similar study. The chi-square statistics test was used to compare mothers' knowledge levels between intervention and control groups in baselines and end-line surveys across the sub-topics. Lastly, to estimate the net effect of the intervention, we calculated the Difference in Difference (DiD), which was presented together with the p-values. All p-values were two-tailed and were deemed statistically significant at 95% CI and $p < .05$.

3. Results

According to the survey results, the sampled participants in the intervention and control sites were comparably similar at baseline and end-line surveys. Most participants were between the age of 20–29 years, had delivered more than once, were married, never attended school, and practiced pastoralism in both intervention and control sites,

as shown in Table 1.

Table 2 compares the knowledge level of maternal and neonatal danger signs in the control and intervention groups at the baseline survey. The chi-square results returned no statistically significant difference in the proportion of women with high and low levels of knowledge in the control and intervention groups on danger signs during pregnancy (p = .259), birth (p = .317), postpartum (p = .133) and neonatal periods (p = .530), implying that both groups had similar levels of knowledge about the maternal danger signs at the beginning of the study.

At the end-line survey, the proportion of women with a high level of knowledge of neonatal danger signs was significantly higher in the intervention group than in the control group [122 (96.8%) vs. 80 (66.7%), p < .0001]. Similarly, there was a significant increase in the level of knowledge of danger signs during pregnancy [113 (89.7%) vs. 75 (62.5%), p < .0001], birth [109 (86.5%) vs. 90 (75.0%), p = .022], and the postpartum period [116 (92.1%) vs. 89 (74.2%), p < .0001] in the intervention group compared to control group respectively as presented in Table 3.

Table 4 presents the effect of the intervention on maternal and neonatal danger signs knowledge levels using Difference-in-Difference (DiD) analysis. We did not employ propensity score matching analysis approaches since the two groups had similar characteristics at baseline. However, Difference-in-Difference (DiD) analysis showed significant differences (p < .0001) in the level of knowledge on neonatal and maternal danger signs across the continuum. The baseline survey revealed that the knowledge level of neonatal danger signs in the control and intervention was as low as 30.3% and 29.6%, respectively. However, we noted a slight improvement at the end-line in the control arm at 62.6% and a marked increase in the intervention arm at 98.6%. The intervention improved knowledge of neonatal danger signs among women with a net intervention effect of 36.7% and p < .0001. The intervention also significantly increased maternal knowledge of danger signs during pregnancy with a net intervention effect of 24.5%, p < .0001. Similarly, the maternal knowledge level of danger signs during and after birth significantly improved after the intervention at the end-line survey with a net intervention effect of 14.3% and 21.7% with p < .0001, respectively. Overall, the HBLSS intervention improved knowledge of maternal danger signs among women from the pastoral community.

Table 2
Knowledge level of maternal and neonatal danger signs in the control and intervention groups at baseline.

Maternal knowledge level	% of mothers		
	High %(n)	Low %(n)	Total %(n)
Knowledge level of neonatal danger signs			
Control	43.0(55)	57.0(73)	50.0(128)
Intervention	46.9(60)	53.1(68)	50.0(128)
p-value	**0.530**		
Knowledge level of danger signs during pregnancy			
Control	50.8(65)	49.2(63)	50.0(128)
Intervention	57.8(74)	42.2(54)	50.4(128)
p-value	**0.259**		
Knowledge level of danger signs during birth			
Control	52.3(67)	47.7(61)	50.0(128)
Intervention	46.1(59)	53.9(69)	50.0(128)
p-value	**0.317**		
Knowledge level of danger signs after birth			
Control	43.0(55)	57.0(73)	50.0(128)
Intervention	47.7(61)	52.3(67)	50.0(128)
p-value	**0.133**		

4. Discussion

In the present quasi-experimental study, we determined the effectiveness of home-based life-saving skills intervention on maternal and neonatal danger signs among women from the pastoralist communities

Table 1
Sociodemographic characteristics of women respondents in the control and intervention groups at baseline and end-line surveys.

	Baseline			End-line		
	Control	Intervention	*P*-value	Control	Intervention	p-value
	n (%)	n (%)		n (%)	n (%)	
Total women	**128(100)**	**128(100)**		**120(100)**	**126(100)**	
Age group						
≤19	13(10.2	8(6.2)	.114	11(9.2)	7(5.6)	0.264
20–29	85(66.4)	76(59.4)		79(65.8)	76(59.5)	
≥30	30(23.4)	44(34.4)		30(25.0)	44(34.9)	
Parity						
Once	30(24.6)	22(17.3)		28(23.3)	20(15.9)	
More than once	92(75.4)	105(82.7)	.158	92(76.7)	106(84.1)	.140
Religion						
Christian	49(38.3)	30(24.2)		46(38.3)	31(24.6)	
Muslim	73(57.0)	90(70.3)		69(57.5)	88(69.8)	
No religion	6(4.7)	7(5.5)	.052	5(4.2)	7(5.6)	.067
Marital status						
Single	0(0.0)	2(1.6)		0(0.0)	1(0.8)	
Married	120(93.0)	119(93.0)		112(93.3)	118(93.7)	
Divorced	2(1.6)	1(0.8)		2(1.7)	1(0.8)	
Widowed	6(4.7)	4(3.1)		6(5.0)	4(3.2)	
Separated	0(0.0)	2(1.6)	.315	0(0.0)	2(1.6)	.442
Ever attended school						
Yes	53(41.4)	47(36.7)		45(37.5)	45(35.7)	
No	75(58.6)	81(63.3)	.442	75(62.5)	81 (64.3)	.581
Level of education						
Primary	37(69.8)	30(63.8)		32(71.1)	27(62.8)	
Secondary	11(20.8)	10(21.3)		10(22.2)	10(23.3)	
College	5(9.4)	7(14.9)	.686	3(6.7)	6(14.0)	.502
Source of income						
Pastoralism	75(60.0)	78(61.9)		75(62.5)	78(62.4)	
Business	31(24.8)	24(19.0)		27(22.5)	22(17.6)	
Formal employment	7(5.6)	5(4.0%)		6(5.0)	5(4.0)	
Casual laborer	12(9.6)	19(15.1)	.194	12(10.0)	20(16.0)	.207

Table 3
Knowledge level of maternal and neonatal danger signs in the control and intervention groups at endline.

Maternal knowledge level	% of mothers		
	High %(n)	Low %(n)	Total %(n)
Knowledge level of neonatal danger signs			
Control	66.7(80)	33.3(40)	48.8(120)
Intervention	96.8(122)	3.2(4)	51.2(126)
p-value	**.000**		
Knowledge level of danger signs during pregnancy			
Control	62.5(75)	37.5(45)	48.8(120)
Intervention	89.7(113)	10.3(13)	51.2(126)
p-value	**.000**		
Knowledge level of danger signs during birth			
Control	75.0(90)	25.0(30)	48.8(120)
Intervention	86.5(109)	13.5(17)	51.2(126)
p-value	**.022**		
Knowledge level of danger signs after birth			
Control	74.2(89)	25.8(31)	48.8(120)
Intervention	92.1(116)	7.9(10)	51.2(126)
p-value	**.000**		

within Marsabit County. This study found that the proportion of women knowledgeable of >3 danger signs increased significantly during pregnancy, birth, postpartum, and neonatal period in the intervention group than the control group post-intervention. These findings are important for global health for several reasons. One, the indigenous pastoralist communities are affected by health challenges relative to the rest of the general population, requiring unique approaches to address them. Secondly, these communities in Kenya live in marginalized areas characterized by limited accessibility and utilization of health care services.[15] Most women from these regions give birth at home aided by traditional birth attendants compared to skilled birth attendants serving the rest of the population.[14,15] Finally, pastoralist women's poverty, illiteracy, and patriarchal societies are barriers to seeking sexual and reproductive health services.

Neonatal danger signs signal severe neonatal complications and must be recognized early and managed immediately. They include convulsion, fever, inability to breastfeed, severe chest in-drawing, breathing difficulty, unconsciousness, yellowing of the palms and soles, hypothermia, umbilicus pus discharge, and eye discharge.[17] Most studies from different parts of the world have emphasized the need for good knowledge and awareness of neonatal danger signs to reduce the neonatal mortality rate, which was the focus of this study.[3,8,13]

Following the intervention, the proportion of women who could identify at least three neonatal danger signs in the intervention group significantly increased compared to women in the control group. This result indicates that the intervention improved the knowledge level of the participants on neonatal danger signs compared to baseline results. These findings are similar to several other intervention studies, that showed community-based programs like HBLSS training improved general awareness of maternal and neonatal danger signs.[7,18,19] Therefore, effort should be made by national and county governments serving hard-to-reach pastoralist communities to enlighten them on neonatal danger signs through home-based life-saving skills interventions. These efforts have the greatest relevance for SDG3, the health goal, which focuses on equity, reaching people needing health services, wherever they live and in their circumstances.[11,20] Since these efforts exclusively apply to women, they also contribute to achieving gender equality while empowering all women and girls by ensuring universal access to reproductive health.

Recognizing danger signs early during pregnancy is critical to ensure proper and timely referrals.[10,21] Furthermore, studies have indicated that the health-seeking behavior among pregnant women is greatly influenced by their knowledge of danger signs of complications during pregnancy, thus preventing maternal morbidity and mortality.[22–26] On the other hand, insufficient knowledge of maternal danger signs during pregnancy contributes to delayed seeking and receiving health care services,[10,22] resulting in maternal mortality.[26,27] In this study, prevalence for each indicator was considerably higher in the intervention group than in the control group at the end-line survey compared to the baseline survey, reinforcing women's reproductive health empowerment.

Similarly, other studies have shown that training and counseling to mothers in rural communities through community health volunteers on obstetric danger signs improves mothers' knowledge of danger signs during pregnancy,[7,10,19,22,28] corroborating our findings. The association between the level of knowledge during pregnancy and health-seeking behavior was not assessed. However, other studies have revealed increased health-seeking behavior among women with high knowledge of danger signs during pregnancy.[7,9,29]

There was no significant difference in the level of knowledge of maternal danger signs during birth and after birth between the control and the intervention groups at the baseline survey in the present study. Nevertheless, there was increased knowledge of maternal danger signs during and after birth in the intervention group than in the control group at the end-line survey. These findings are consistent with a study in Ethiopia, which indicated that women who received health education on obstetric danger signs from healthcare providers had a 3.6-fold increased chance of having a high knowledge of obstetric danger signs.[13] Therefore, this study findings indicate that HBLSS is necessary for mothers from the pastoral community to enhance their knowledge of obstetric danger signs and consequently improve their health-seeking behavior, thereby reducing maternal mortality.

4.1. Strength of the study

The strength of this study lies in its targeted approach to address a critical public health issue in a vulnerable population. By focusing on pastoralist women in a region with unique healthcare challenges, the study demonstrates a commitment to improving maternal and child health outcomes in underserved communities. The quasi-experimental design used in this study allows assessing the intervention's impact in a real-world context, where randomization might not be feasible. The study's emphasis on empowering women with life-saving skills at home aligns with a culturally sensitive and community-centered approach.

Table 4
Difference in Difference analysis of the effect of the HBLSS Intervention on maternal and neonatal danger signs between intervention and control groups at baseline and endline surveys.

Knowledge of maternal danger signs	Baseline survey			End line survey			Contribution
	C (%)	I (%)	Diff(I–C)	C (%)	I (%)	Diff(I–C)	DiD
Knowledge level of neonatal danger signs	30.3	29.6	−0.7	62.6	98.6	36***	36.7***
Knowledge level of danger signs during pregnancy	34.9	33.4	−1.5	35.6	58.6	23***	24.5***
Knowledge level of danger signs during birth	39.9	37.3	−2.6	46.3	58.8	11.7***	14.3***
Knowledge level of danger signs after birth	26.2	26.1	−0.1	31.8	53.4	21.6***	21.7***

***p < .0001; C, control group; I, intervention group; Diff, difference; DiD, difference in differences.

4.2. Study limitation

This study has a few limitations. The quasi-experimental design used lacks the randomization typically found in randomized controlled trial, this could be a potential source of selection bias. Additionally, the study's reliance on self-reported data may introduce recall bias. However, this was minimized by verifying the data using maternal and child health booklet. Attrition rate of 3.9% among the study participants during endline survey was observed. This research might not have also captured other factors beyond the intervention, such as community-level changes or external health initiatives which might have influenced the outcomes. Lastly, the generalizability of the findings may be limited to similar pastoralist populations in other regions.

5. Conclusion

Our study has demonstrated that HBLSS intervention successfully improved the knowledge level of danger signs during pregnancy, birth, and after birth, as well as the neonatal period among women from the pastoralist community. This implies that the integration of community-based interventions such as HBLSS with the existing healthcare systems could improve knowledge among women in rural settings on maternal and neonatal danger signs. Consequently, it improves health-seeking behavior and reduces maternal morbidity and mortality among women of reproductive age in a rural population.

Author contributions statement

Dabo Galgalo: Conceptualization; Methodology; Acquisition of data; Statistical analysis; Writing-original draft preparation; Writing – reviewing and editing.

Elijah Maranga: Data curation, Statistical analysis, Writing – original draft; Writing – reviewing and editing.

Japheth Mativo: Methodology; Study implementation; Supervision; Writing – reviewing and editing.

John Gachohi: Methodology; Statistical analysis; Supervision; Writing – reviewing and editing.

All the authors reviewed and approved the final manuscript.

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Declaration of competing interest

None.

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