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Improving Newborn Health Knowledge Through Structured Maternal Education in Dar es Salaam, Tanzania

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ABSTRACT

Background: Neonatal mortality remains high in low- and middle-income countries. Mothers' knowledge of Essential Newborn Care (ENC) and neonatal danger signs is crucial for promoting appropriate neonatal care, facilitating early recognition of illness, and reducing neonatal mortality. Structured health education may improve maternal knowledge; however, evidence of its effectiveness in routine hospital settings remains limited.

Objective: To evaluate the effectiveness of health education intervention on postnatal mothers' knowledge of ENC and neonatal danger signs.

Methods: A quasi-experimental pre–post study using independent cross-sectional samples was conducted among postnatal mothers in four public hospitals in Dar es Salaam, Tanzania. The post- intervention survey (2021) included 825 mothers and was compared with a pre-intervention sample of 825 mothers from 2019. A structured maternal health education package was implemented between the two time points. Data were collected using structured questionnaires assessing maternal knowledge of ENC and neonatal danger signs. Descriptive statistics and logistic regression analyses were performed, adjusting for sociodemographic and care-related confounders. Statistical significance was set at $P<.05$.

Results: Post-intervention mothers had higher levels of education (34.7% vs 28.7%. $P=.001$), employment (10.2% vs 5.2%; $P=.001$), and caesarean delivery (30.9% vs 21.9%; $P=.025$), but lower uptake of ≥4 antenatal care visits (81.0% vs 85.4%; $P=.003$). A higher proportion of post- intervention mothers had heard of neonatal danger signs (92.4% vs 85.8%; $P<.001$) and correctly identified at least 50% of them (41.6% vs 36.7%; $P=.044$). They were more than twice as likely to correctly identify danger signs (adjusted OR, 2.38; 95% CI, 1.63–3.48). Maternal knowledge was also positively associated with ≥4 antenatal care visits, receipt of postnatal health education, and delivery at lower-volume hospitals.

Conclusion: The structured health education intervention was associated with higher maternal knowledge of neonatal danger signs and ENC, although gaps remained in breastfeeding and some infection prevention practices. Knowledge was greater among mothers with four or more antenatal care visits, those delivering at lower-volume hospitals, and those exposed to postnatal education. Future longitudinal studies are needed to assess knowledge retention and how it translates into actual newborn care practices.

BACKGROUND

Over the past few decades, there has been significant progress in reducing child mortality globally. However, the Neonatal Mortality Rate (NMR) remains unacceptably high.[1] Most newborn deaths occur in low- and middle-income countries, such as Tanzania, where the NMR is estimated at 24 per 1,000 live births.[2] This rate falls significantly short of the Sustainable Development Goal (SDG) target 3.2, which aims for all countries to reduce neonatal mortality to less than 12 deaths per 1,000 live births by 2030.[3] The implementation of basic, cost-effective, evidence-based interventions, collectively known as Essential Newborn Care (ENC) is critical for safeguarding the health and well-being of newborns, during the early days and weeks of life.[4] Implementation of ENC has been shown to reduce neonatal mortality, with receipt of a single component lowering risk by nearly half and all four components reducing it by almost three-quarters.[5] The key components of ENC (cleanliness, breastfeeding, cord care, eye care, thermoregulation, immunisation, care for low-birth-weight infants, and recognition of neonatal danger signs) form the foundation of routine health education offered to postnatal mothers prior to hospital discharge in Tanzanian. Evidence indicate that empowering mothers with comprehensive knowledge of ENC practices and neonatal danger signs is crucial for preventing neonatal deaths.[6-11]

The antenatal and postnatal periods are critical windows for improving maternal knowledge of ENC and reducing neonatal mortality by equipping mothers to recognise danger signs and practice appropriate newborn care through facility and community based counselling.[12] Four or more antenatal care visits with a skilled provider improve neonatal survival and growth, and even a single visit can reduce mortality by nearly forty percent in sub-Saharan Africa.[13] Furthermore, counselling on ENC during ANC enhances maternal knowledge, which is critical for reducing neonatal mortality.[14] However, increasing the number of visits without ensuring high-quality care may not yield the desired impact.[15]

ANC uptake is shaped by cultural, economic, and health system factors. Although male involvement is recognised as a strategy to improve attendance, participation remains constrained by traditional gender roles. In Tanzania, where ANC utilisation is still suboptimal, only 34% of women initiate care in the first trimester and 65% complete at least 4 visits[16], while male participation in ANC ranges from 54% to 69%,[17,18]. Moreover, despite rising coverage in many settings, ANC quality often lags behind particularly in low-income countries thereby limiting its effectiveness in improving maternal knowledge and neonatal outcomes.[19] Given the importance of postnatal health education, a structured, pre-discharge educational program with post-discharge reinforcement utilising a multi-faceted teaching approach may be essential.[20]

A study conducted in 2019 in collaboration between the Comprehensive Community-Based Rehabilitation in Tanzania (CCBRT), Muhimbili University of Health and Allied Sciences (MUHAS), and Muhimbili National Hospital (MNH), revealed that despite routine health education, postnatal mothers in four referral hospitals had limited knowledge of ENC.[21]

To address this gap, CCBRT, in partnership with MUHAS and MNH developed a structured training package based on ENC principles, designed to be delivered during health education sessions. The current study aims to assess the effectiveness of this structured training intervention in improving postnatal mothers' knowledge of ENC and neonatal danger signs in Dar es Salaam, Tanzania.

METHODS

Study Design

This study employed a quasi-experimental pre–post design using independent cross-sectional samples of postpartum mothers from the same health facilities at two time points. The design enabled evaluation of the intervention under real-world conditions, providing practical insights into its effectiveness within routine care. The pre-intervention study, conducted in 2019, assessed maternal knowledge of essential ENC and neonatal danger signs. At that time, mothers received routine facility-based health education, which was unstandardized and lacked a structured training package. Findings revealed significant knowledge gaps. In response, the research team collaborated with nurses from the participating hospitals to co-create a structured health education package, which was implemented in 2020. The intervention standardized content and delivery methods, including health talks, posters, and video-assisted education. The post-intervention study, conducted in 2021, enrolled a separate cohort of postpartum mothers from the same facilities to evaluate knowledge following implementation of the structured package.

Theory of Change

The intervention was guided by a Theory of Change hypothesising that replacing routine, non-standardised health education with a structured and standardized package would improve the consistency and quality of maternal education. Enhanced exposure to key messages on ENC and neonatal danger signs was expected to increase maternal knowledge before discharge.

Study Setting

The study was carried out in 4 public referral hospitals in Dar es Salaam, Tanzania: Muhimbili National Hospital, a tertiary-level facility that recorded 10,232 deliveries in 2019; and the regional referral hospitals of Mwananyamala, Amana, and Temeke, which reported 11,328, 13,688, and 10,185 deliveries, respectively, during the same year. These hospitals were also involved in the pre-intervention study conducted in 2019, as well as in the development and implementation of the training package in 2020.

Participants and Sample Size

At both study time points (2019 and 2021), postnatal mothers admitted with their newborns were eligible if they provided informed consent. Mothers who were healthcare workers, were critically ill, or had critically ill newborns were excluded. The pre- and post-intervention surveys enrolled independent samples of mothers. The sample size was determined using the Kish and Leslie formula with 80% power and a 5% margin of error. Based on a 64% baseline knowledge of ENC reported in the pre-intervention study [21], and assuming a 50% relative increase post-intervention, the minimum required sample size adjusted for design effect and 20% attrition was estimated to be 825 postnatal mothers.

Sampling Procedure

Participant enrolment was proportionally based on the average number of deliveries and admissions at each hospital. A consecutive sampling approach was employed, eligible postnatal mothers who provided informed consent were enrolled until the required sample size for each facility was reached. Each mother infant pair was enrolled only once, identified by a unique hospital admission number. To avoid duplication, hospital records were reviewed to exclude re-admitted pairs. Additionally, mother-infant pairs referred to MNH from RRHs were excluded if they had participated in the study prior to referral.

Data Collection and Measurement

Trained research assistants, all professionally qualified nurses who were not involved in patient care conducted face-to-face interviews with postnatal mothers using a structured, standardised questionnaire. This tool, originally used in the pre-intervention study, was slightly modified to include questions on health education delivery methods. The questionnaire was pilot tested with 40 mothers (10 per hospital) to ensure clarity

and validity; pilot data were excluded from analysis. The instrument showed good reliability, with Cronbach's alpha of 0.7972 for ENC and 0.7679 for danger sign items.

Data was collected on participants' demographic characteristics, obstetric history and knowledge of ENC and eight key neonatal danger signs: poor feeding, lethargy, convulsions, hypothermia, fever, chest indrawing, difficulty breathing, and jaundice. Independent variables included age, marital status, education level, and receipt of ENC information during antenatal or postnatal sessions.

Knowledge was assessed with open-ended questions. Correct responses were scored as 1 and 0 for incorrect. Mothers identifying at least four neonatal danger signs, scoring ≥50% in each ENC domain were classified as having good knowledge. The primary outcomes were maternal knowledge of neonatal danger signs and ENC practices. To assess the intervention's effect, post-intervention results were compared with those from the pre-intervention Survey. The study was reported in accordance with the STROBE guidelines for cross-sectional studies.

Data Analysis

Data were analysed using Stata version 18 (Stata Corporation, College Station, USA). The pre- and post-intervention study datasets were merged prior to analysis. Descriptive statistics were summarised as frequencies and proportions. Differences between pre- and post-intervention groups were assessed using chi-square tests. Logistic regression analysis was employed to assess the association between the intervention and maternal knowledge of neonatal danger signs while adjusting for key potential confounders, including maternal age, education level, occupation, parity, and antenatal care attendance. To improve the overall fit of the regression model and improve the model's predictive accuracy, variables with p-value <.2 was considered for inclusion in the final model. The results are presented as Crude Odds ratio (cOR) and adjusted odds ratio (aOR) with corresponding 95% confidence intervals (CIs). Statistical significance was set at $p<.05$.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board of Muhimbili University of Health and Allied Sciences (MUHAS-REC-07-2021-770). Administrative permission to conduct the study was granted by the relevant authorities of all participating hospitals.

Participation was voluntary, and written informed consent was obtained from all mothers prior to data collection.

RESULTS

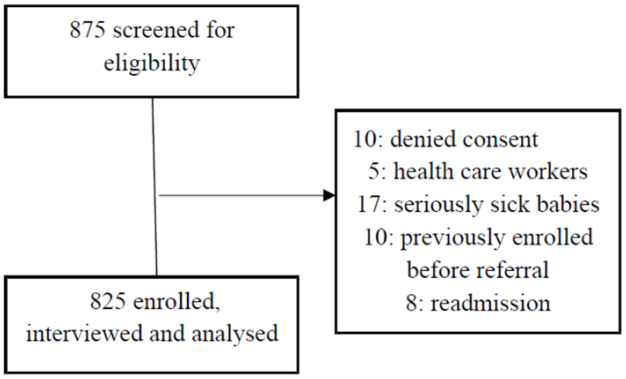
Study Participants

A total of 875 postnatal mothers were screened during the post-intervention phase, of whom 825 met the inclusion criteria and were interviewed (Figure 1). These were combined with 825 post-intervention participants from the 2019 pre-intervention survey, resulting in a total analytic sample of 1,650 participants.

Characteristics of Study Participants

Compared with the pre-intervention group, a higher proportion of post-intervention mothers had completed secondary education (34.7% vs 28.7%; *P*=.01), were employed (10.2% vs 5.2%; *P*=.001), and had delivered by caesarean section (30.9% vs 21.9%; *P*=.025). Fewer post-intervention mothers attended at least four antenatal care visits (81.0% vs 85.4%; *P*=.003). There were no significant differences between groups in marital status, parity, place of birth, or hospital of delivery (Table 1).

FIGURE 1: Flow Diagram of Postnatal Mothers Enrolled in the Post Intervention Study



Exposure to Health Education

Among post-intervention mothers, 758 (91.9%) reported receiving health education during the antenatal and postnatal periods, with the primary mode of delivery being health talks (80%), followed by videos (13%) and posters (7%). Receipt of health education was significantly higher in the post-intervention group compared with the pre-intervention group during both the antenatal period (53.0% vs 33.1%; *P*<.001) and the postnatal period (87.2% vs 70.5%; *P*<.001). Post-intervention mothers more frequently received information on thermoregulation, care of preterm infants, hygiene, and immunisation, whereas fewer received information on breastfeeding and cord care (Table 2).

Maternal Knowledge of Essential Newborn Care

Following the intervention, maternal knowledge of ENC was higher, although some gaps persisted (Table 3). Compared with the pre-intervention group, a higher proportion of post-intervention mothers correctly identified key thermoregulation practices, including the importance of warm clothing (55.0% vs 42.2%; *P*<.001) and delaying the first bath to prevent heat loss (66.9% vs 53.4%; *P*<.001). Knowledge of cord care, hygiene, and immunisation also increased, with more mothers correctly reporting that the umbilical cord should not be covered (62.8% vs 44.1%; *P*<.001), recognising that timely diaper changes help prevent infection (49.8% vs 29.1%; *P*<.001), and identifying Bacille Calmette–Guérin vaccine (BCG) and polio as essential newborn vaccines (65.0% vs 55.2%; *P*<.001).

TABLE 1: Socio-Demographic and Obstetric Characteristics of Postnatal Mothers in Dar es Salaam Before and After the Training Intervention

Variable	Pre-intervention (n, %)	Post-intervention (n, %)	*P value*
Maternal Age (in years)			
Less than 19	94 (11.4)	65 (8.4)	
20-29	457 (55.4)	446 (57.5)	
30-39	255 (30.9)	227 (29.3)	.01
40-49	19 (2.3)	37 (4.8)	
Marital Status			
Married	592 (71.8)	605 (73.3)	.47
Not Married	233 (28.2)	220 (26.7)	
Education Level			
Never been to school	57 (6.9)	54 (6.5)	
Primary school	489 (59.3)	388 (47.0)	.001
Secondary school	237 (28.7)	286 (34.7)	
College or university	42 (5.1)	97 (11.8)	
Employment Status			
Employed	43 (5.2)	84 (10.2)	
Self-employed	530 (64.2)	510 (61.8)	.001
Unemployed	252 (30.5)	231 (28.0)	
Parity			
Primiparous	351 (42.5)	360 (43.6)	.65
Multiparous	474 (57.5)	465 (56.4)	
Mode of Delivery			
Spontaneous vaginal delivery	644 (78.1)	600 (72.7)	
Caesarean section	181 (21.9)	225 (27.3)	.025
Place of Birth			
Hospital	813 (98.5)	803 (97.3)	
Home	12 (1.5)	22 (2.7)	.13
Number of ANC Visits			
None	3 (0.4)	11 (1.33)	
Less than 4	117 (14.2)	146 (17.7)	.003
4 or more	705 (85.4)	668 (81.0)	
Hospitals (deliveries in 2019)			
Amana (13688)	166 (20.1)	169 (20.5)	
Muhimbili (10232)	329 (39.9)	320 (38.8)	.21
Mwananyamala (11328)	164 (19.9)	168 (20.4)	
Temeke (10185)	166 (20.1)	168 (20.4)	

ANC-Antenatal clinic

TABLE 2: Health Education on Essential Newborn Care Received by Postnatal Mothers in Dar es Salaam Before and After the Training Intervention.

Variable	Pre-intervention (n, %)	Post-intervention (n, %)	*P value*
	ANTENATAL PERIOD		
Education on ENC received	n = 825	n = 825	
Yes	273 (33.1%)	445 (53.9%)	.001
No	552 (66.9%)	380 (46.1%)	
Source of ENC education	n = 273	n = 445	
Doctors	8 (2.9%)	35 (4.2%)	
Nurses	247 (90.4%)	399 (90.0%)	
Mass media	3 (1.1%)	4 (0.9%)	
Family/Friends	15 (5.5%)	7 (1.6%)	.001

Continue

TABLE 2: Continued

Variable	Pre-intervention (n, %)	Post-intervention (n, %)	*P value*
ENC information received on*	n = 273	n = 445	
Breastfeeding	237 (86.8%)	341 (76.6%)	.001
Cord care	57 (20.9%)	45 (10.1%)	.001
Eye care	14 (5.1%)	20 (4.5%)	.69
Thermoregulation	19 (7.0%)	90 (20.2%)	.001
Care of preterm	13 (4.8%)	45 (10.1%)	.011
Danger signs	140 (51.3%)	230 (51.7%)	.99
Immunization	60 (22.0%)	145 (32.6%)	.002
Hygiene	30 (11.3%)	16 (3.1%)	.001
	POSTNATAL PERIOD		
Education on ENC received (PNC)	n = 825	n = 825	
Yes	582 (70.5%)	719 (87.2%)	.001
No	243 (29.5%)	116 (13.3%)	
Source of ENC education PNC	n = 582	n = 719	
Doctors	30 (5.2%)	63 (8.8%)	
Nurses	504 (86.6%)	650 (90.4%)	
Family/Friends	39 (6.7%)	1 (0.14%)	.001
Mass media	9 (1.5%)	5 (0.69%)	
ENC information received on*	n = 582	n = 719	
Breastfeeding	543 (93.2%)	574 (79.8%)	.001
Cord care	227 (39.0%)	91 (12.7%)	.001
Eye care	34 (5.8%)	34 (4.7%)	.35
Thermoregulation	70 (12.0%)	148 (20.6%)	.001
Care of preterm	24 (4.1%)	100 (13.9%)	<.001
Danger signs	393 (67.5%)	510 (70.9%)	.24
Immunization	312 (53.6%)	384 (48.4%)	.77
Hygiene	60 (10.3%)	428 (59.5%)	.001

ENC- Essential Newborn Care, PNC-Postnatal Care; ENC information received on* multiple responses possible

TABLE 3: Postnatal Mothers' Knowledge of Essential Newborn Care Components in Dar es Salaam Before and After the Training Intervention

Variable	Pre-intervention (n, %)	Post-intervention (n, %)	*P value*
Correct knowledge on			
Breastfeeding			
Baby should be breastfed within one hour	541 (65.6)	523 (63.4)	.35
Baby should not be given pre-lacteal feeds	747 (90.5)	763 (92.5)	.19
Baby should be given colostrum	785 (95.2)	793 (96.1)	.65
Breastfeeding on demand	697 (80.5)	532 (64.5)	<.001
Exclusive breastfeeding for 6 months	771 (93.5)	783 (94.9)	.24
Thermoregulation			
Skin-to-skin contact	593 (71.8)	500 (60.6)	<.001
Warm clothing	348 (42.2)	454 (55.0)	<.001
Postpone first bath (after 24hrs)	441 (53.4)	552 (66.9)	<.001
Nurse baby in the same room as mother	810 (98.2)	803 (97.4)	.31
Warm room	389 (47.2)	392 (47.5)	.88
Cord Care			
Umbilical cord should not be covered	364 (44.1)	518 (62.8)	<.001
Nothing should be applied to the cord	633 (76.7)	658 (80.0)	.08
Infection can occur through the umbilical cord	698 (94.6)	675 (95.0)	.25
Hygiene to prevent infection			

Continue

TABLE 3: Continued

Variable	Pre-intervention (n, %)	Post-intervention (n, %)	*P value*
Washing hands before breastfeeding	443 (53.7)	343 (41.6)	<.001
Washing hands after changing diaper	157 (19.0)	212 (25.7)	.32
Changing diaper on time	240 (29.1)	411 (49.8)	<.001
Washing hands after toilet	166 (20.1)	205 (24.8)	.84
Signs of eye infection			
Eye swelling	222 (26.9)	225 (27.3)	.87
Eye discharge	655 (79.4)	518 (62.8)	<.001
Immunisation			
Newborns need immunisation	820 (99.4)	815 (98.8)	.35
Immunisation prevents diseases	800 (97.0)	796 (96.5)	.35
Newborns are immunised against TB & polio	455 (55.2)	536 (65.0)	<.001

ENC: essential newborn care, TB: Tuberculosis

Awareness of Neonatal Danger Signs

Awareness of neonatal danger signs increased significantly following the intervention. A higher proportion of post-intervention mothers reported having heard of neonatal danger signs compared with the pre-intervention group (92.4% vs 85.8%; *P*<.001). Although no mother identified all eight key danger signs, post-intervention mothers were more likely to recognise hypothermia (23.8% vs 14.7%; *P*<.001), convulsions (45.7% vs 32.9%; *P*< .001), lethargy (15.4% vs 7.5%; *P*<.001), jaundice (65.0% vs 53.6%; *P*=.01), and chest indrawing (7.5% vs 2.1%; *P*< .001). Recognition of fever and inability to breastfeed was similar in both groups. Overall, a greater proportion of post-intervention mothers correctly identified at least 50% of the major danger signs compared with the pre-intervention group (41.6% vs 36.7%; *P*=.044) (Table 4).

Predictors of Maternal Knowledge of Neonatal Danger Signs

As shown in Table 5, the adjusted logistic regression model indicated that post-intervention mothers were 2.38 times more likely to correctly identify at least 50% of neonatal danger signs (95% CI, 1.63–3.48; *P*<.001). The model adjusted for maternal age, employment status, parity, number of antenatal care visits, delivery hospital, and receipt of health education during both antenatal and postnatal periods. The intervention (a structured/ standardised maternal education package), delivery in hospitals with lower birth volumes, and receipt of postnatal health education were the strongest positive predictors of maternal knowledge of neonatal danger signs.

TABLE 4: Postnatal Mothers' Knowledge of Neonatal Danger Signs in Dar es Salaam Before and After the Training Intervention

Variable	Pre-intervention (n, %)	Post-intervention (n, %)	*P value*
Ever heard of neonatal danger signs			
Yes	708 (85.8%)	762 (92.4%)	<.001
No	117 (14.2%)	63 (7.6%)	
Able to mention danger signs			
Fever	604 (73.2%)	628 (76.1%)	.17
Hypothermia	121 (14.7%)	196 (23.8%)	<.001
Convulsions	271 (32.9%)	377 (45.7%)	<.001
Lethargy	62 (7.5%)	127 (15.4%)	<.001
Difficulty in breathing	251 (30.5%)	122 (14.5%)	<.001
Chest indrawing	12 (2.1%)	62 (7.5%)	<.001
Jaundice	441 (53.6%)	494 (59.9%)	.010
Inability to breastfeed	541 (65.7%)	528 (64%)	.48

Continue

TABLE 4: Continued

Variable	Pre-intervention (n, %)	Post-intervention (n, %)	*P value*
Able to mention at least 50% of danger signs			
Yes	303 (36.7%)	343 (41.6%)	.044
No	522 (63.3%)	482 (58.4%)	
Able to mention 50% of danger signs by hospital			
Amana (deliveries =13688)	121(40.0)	239(70.0)	
Muhimbili (deliveries =10232)	11 (3.6%)	41 (12%)	<.001
Mwananyamala (deliveries =11328)	34 (11.2%)	23 (6.7%)	
Temeke (deliveries =10185)	137 (45.2%)	39 (11.4%)	

TABLE 5: Factors Associated with Knowledge of ≥50% of Neonatal Danger Signs Among Postnatal Mothers in Dar es Salaam Before and After the Training Intervention.

Variable	Crude OR (95% CI)	*P value*	Adjusted OR (95%CI)	*P value*
Intervention	2.38(1.63, 3.48)	<.001	2.06 (1.08, 3.94)	.029
Maternal age (years)				
Less than 20	Ref			
20-29	2.60(1.45, 4.64)	.001	1.85 (0.72, 4.78)	.20
30-39	4.32(2.32, 8.07)	<.001	1.19 (0.39, 3.66)	.76
40-49	6.68(1.76, 25.4)	.005	1.07 (0.20, 5.64)	.76
Education Level				
Never been to school	Ref			
Primary school	1.92(0.93, 3.95)	.08	-	-
Secondary school	1.49(0.69, 3.18)	.31	-	-
College or university	2.10(0.79, 5.63)	.14	-	-
Employment status				
Employed	0.98(0.47, 2.05)	.95	0.25 (0.09, 0.71)	.09
Self employed	1.99 (1.31, 3.02)	.001	1.37 (0.71, 2.65)	.77
Unemployed	Ref			
Marital status				
Married	1.87(1.22, 2.85)	.004	1.14(0.59, 2.20)	.69
Not married	Ref			
Antenatal visit				
Less than 4	Reference			
4 or more	6.73(1.17, 38.57)	.032	4.37(2.08, 9.19)	<.001
Parity				
One	Ref			
More than 1	2.43(1.66, 3.56)	<.001	1.26(0.65, 2.45)	.49
Delivery mode				
Caesarean section	Ref			
Vaginal	1.34(0.88, 2.05)	.17		
Hospitals (no of deliveries)				
Amana (13688) Ref				
Muhimbili (10232)	18.7(10.0, 35.03)	<.001	13.0(5.87, 28.88)	<.001
Mwananyamala (11328)	1.31(0.64, 2.72)	.45	1.34(0.52, 3.42)	.54
Temeke (10185)	15.61 (7.7, 31.7)	<.001	13.7(5.32,35.49)	<.001
Health education received				
During Antenatal care	2.07 (1.36, 3.14)	.001	1.61(0.86, 3.03)	.14
During postnatal care	31.13(16.7,57.91)	<.001	15.41(7.35,32.28)	<.001

CI: Confidence interval; OR: Odds Ratio

DISCUSSION

This study assessed the impact of a structured health education intervention on maternal knowledge of neonatal danger signs and ENC in Dar es Salaam, Tanzania. The intervention was developed based on gaps identified in a 2019 pre-intervention baseline study.[21] Findings from the pre-intervention study informed the development of structured educational materials delivered through health talks, posters, and videos, prior to the post-intervention assessment. A higher proportion of mothers in the post-intervention group received health education during both ANC and PNC compared to the pre-intervention group. Notably, exposure to health education during ANC and PNC increased, and these mothers more frequently recognised critical danger signs such as jaundice, convulsions, and chest indrawing. Overall, knowledge of neonatal danger signs was higher and independently associated with the intervention. Other factors associated with better knowledge of danger signs included attending ≥4 ANC visits and delivery at lower-volume hospitals. These findings align with previous studies showing that health education promotes early recognition of danger signs, crucial for timely healthcare-seeking and improved neonatal outcomes.[22,23]

Although fewer post-intervention mothers attended ≥4 ANC visits, we speculate that higher education enhanced knowledge retention. Despite an increase in neonatal danger sign knowledge, ENC knowledge remained mixed, likely because danger signs are urgent, concise messages, whereas ENC practices are detailed, behaviour-based, and require repeated reinforcement. Post-intervention mothers had higher education and employment levels, generally associated with better health knowledge[24,25], yet knowledge of breastfeeding and infection prevention remained suboptimal. This may be partly explained by reduced ANC visits, limiting exposure to consistent health messages.[13] These findings support evidence that education and employment alone are insufficient without adequate and high-quality health education during ANC and PNC.[14,25,26] A particularly concerning finding was the decline in breastfeeding knowledge post-intervention. Despite high reported exposure to breastfeeding education, fewer mothers correctly identified the need to initiate breastfeeding within the first hour and to feed on demand. Given the crucial role of breastfeeding knowledge in promoting initiation and continuation[27,28], the observed decline underscores the need to strengthen counselling approaches and ensure sufficient time for comprehensive breastfeeding education.

Preventing hypothermia is critical to reducing neonatal mortality.[29,30] Although prior studies suggest that thermoregulation education emphasises individual practices[31,32], our findings indicate that knowledge remained mixed despite high reported exposure, as more post intervention mothers identified warm dressing and delayed bathing as key practices, yet fewer recognised skin-to-skin contact as essential. Similarly, post-intervention, mothers were more likely to identify timely diaper changes and leaving the umbilical cord uncovered as Infection preventive measures. However, fewer recognised eye discharges as a sign of neonatal infection. These findings are consistent with other African studies reporting limited maternal awareness of infection control.[6,22,33]

Given the role of infection prevention in reducing neonatal sepsis related mortality[34], these results underscore the need for clearer and more consistent health education messaging focused on infection prevention. Knowledge of immunisation remained high, with significant higher maternal awareness of key neonatal vaccines. This contrasts with earlier studies reporting low vaccine knowledge among postnatal mothers[6] but aligns with findings that health education improves immunisation awareness.[23,35]

The high levels observed may reflect strong national advocacy and routine vaccine messaging. Identifying the drivers of this success may help address knowledge gaps in other areas where post-intervention understanding declined. Some unexpected findings may reflect implementation constraints during the COVID-19 pandemic. Shorter hospital stays compressed ENC sessions and reduced opportunities for reinforcement. Limited use of audiovisual learning tools and reliance on brief health talks may have reduced message retention. Previous studies show that interactive and visual methods improve knowledge retention,[28,31,32,36-38] and their underuse may have limited intervention effectiveness. This implementation gap highlights the need for strategies that ensure consistent use of diverse and engaging educational methods, especially during health system disruptions. The limited benefits observed from the intervention contrast with studies reporting marked improvements following health education.[39-42] This difference may be attributed to our use of independent pre- and post-intervention groups, which can reduce the observable changes compared to longitudinal designs tracking the same cohort over time.

Study Limitations

This study has several limitations. Conducting the study in an urban setting may limit generalisability of findings to rural areas with different healthcare dynamics. The quasi-experimental design using independent samples limits causal inference, and findings may be affected by unmeasured confounding. Knowledge was self-reported, introducing potential recall or social desirability bias. In addition, post-intervention assessment captured only short-term knowledge without evaluating retention or translation into practice.

Despite these limitations, the study provides evidence that a structured and standardised maternal education package can improve maternal knowledge of most ENC components and neonatal danger signs in routine hospital settings.

CONCLUSION

The structured health education intervention was associated with improved maternal knowledge of neonatal danger signs and ENC, although gaps persisted in breastfeeding and some infection prevention practices. Higher knowledge was observed `among mothers who attended at least four antenatal care visits, delivered at lower-volume hospitals, and received postnatal health education. Future longitudinal studies are needed to assess the long-term retention of knowledge and its translation into actual newborn care practices.

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