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Prevalence and Factors Associated with Hypothermia among Neonates in Regional Referral Hospitals in Dar es Salaam, Tanzania

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Abstract

Background: Neonatal hypothermia is a major cause of mortality. This study determined the prevalence and factors associated with neonatal hypothermia in two regional referral hospitals in Dar es Salaam, Tanzania.

Methods: Cross-sectional study was carried out between March and May 2021 at the Mwananyamala and Temeke Regional Referral Hospitals. Simple random and stratified sampling procedures were used to select study sites and proportionate population samples from each hospital respectively. Body temperature was measured within 90 minutes post birth; knowledge of the WHO guidelines on thermal protection of new-borns was collected from the mothers and health care providers using questionnaires. Logistic regression was used to assess associations between variables. SPSS version 25 was used to analyse the data and $p < 0.05$ was considered significant.

Results: Total of 296 mother-new-born pairs and 41 health care providers were enrolled in the study. 26 mothers did not consent for the study. 25.6% of the 270 studied neonates were hypothermic. Lack of skin-to-skin contact with the mother; early neonatal weighing and bathing increased likelihood of neonatal hypothermia. Knowledge of neonatal thermal protection among mothers and care-providers was inadequate.

Conclusions: The prevalence of neonatal hypothermia among neonates in the referral hospitals is high. The findings suggest knowledge gaps of the WHO recommended guidelines on neonatal hypothermia are associated with neonatal hypothermia. Efforts to increase awareness of the WHO recommended thermal protection guidelines are needed.

Keywords: Warm chain, hypothermia, skin-skin-contact, inadequate knowledge

1. Introduction

New-born's ability to maintain normal body temperature easily becomes overwhelmed by environmental factors. The new-born body temperature ranges between 36.5 ºC and 37.5 ºC attained through physiological temperature regulation processes controlled from the brain (hypothalamus) and mediated via endocrine pathways through shivering and non-shivering thermogenesis (Knobel & Holditch, 2007; Onalo, 2013). Premature and low birth weight neonates are more likely to die from hypothermia especially during the first 6–12 hours after birth (Tasew, Gebrekristos, Kidanu, Mariye, & Teklay, 2018; Bayih, Assefa, Dheresa, Minuye, & Demis, 2019; Ukke & Diriba, 2019). Thermal protection of the new-born, therefore, should start at birth. The World Health Organisation (WHO) defined neonatal hypothermia as core body temperature < 36.5 °C or a skin temperature < 36 °C, categorized into mild or cold stress 36.0–36.4 °C, moderate 32.0–35.9 °C and severe < 32 °C (WHO, 1993).

Studies have reported variations in the prevalence of neonatal hypothermia ranging between 11–92% and in the developing countries, hypothermia is among major contributors to neonatal morbidity and mortality (Bang, Reddy, Baitule, Deshmukh, & Bang, 2005; Darmstadt, Kumar, Yadav, Sing et al., 2005). Community-based studies have reported that neonatal hypothermia occurs at all seasons although the risk was higher during cold seasons (Kambarami, Chidede, & Pereira, 2003; Mullany, Katz, Khatry, LeClerq, Darmstadt, & Tielsch, 2010; Lunze, Bloom, Jamison, & Hamer, 2013).

Morley (1960) reported neonatal hypothermia in the tropics and in 2008, Sodemann et al. reported 8% prevalence

of neonatal hypothermia in Guinea Bissau, West Africa. Much higher prevalence was reported in Ethiopia (Demissie, Abera, Chichiabellu, & Astawesegn, 2018; Yitayew, Aitaye, Lechissa, & Gebeyehu, 2020). Similarly, Beletew, Mengesha, Wudul, & Abate, (2020) reported 57.2% prevalence of neonatal hypothermia and delay in initiation of breastfeeding, neonatal health problem, low birth weight, preterm and nighttime delivery were significant risk factors of neonatal hypothermia in Ethiopia.

Neonatal hypothermia prevalence ranging between 44% and 69% were reported in Zambia (Hamer et al., 2012). Similar high prevalence has been reported in the region (Christensson, Bhat, Eriksoson, Shilalukey-Ngoma, & Sterky, 1995; Kambarami & Chidede, 2003). Studies in South Africa have reported lower prevalence of between 3% and 21% (Ballot, Chirwa, & Cooper, 2010; Thwala, 2012) respectively. Advanced equipment and meticulous neonatal care facilities were associated with the low prevalence in that region.

Despite launching of the WHO recommended thermal protection guidelines for the prevention of neonatal hypothermia in 1994, neonatal hypothermia remains a challenge in resource limited countries. It is estimated that delivery of the recommended interventions at health facilities would decrease new-born deaths by about 71% (Berhe, Medhaniye, Kahsay, Birhane, & Abay, 2017). Studies in East Africa have also reported varying prevalence of neonatal hypothermia ranging between 79% and 1.3% (Byaruhanga, Bergstrom, & Okong, 2005; Mekonnen, Tenu, Aklilu, & Abera, 2018) respectively.

The Tanzania Vision 2025 aims to attain 75% of all health facilities offering essential new-born care during deliveries (Tanzania Ministry of Health, 2020). However, despite that WHO recommended thermal protection guidelines over a decade ago, a study which examined hypothermia in new-borns in Dar es Salaam Tanzania reported prevalence of 22.4% on admission and 48% and 52% of neonatal deaths were due to improper care provided to the mothers and neonates, respectively (Manji & Kissenge, 2003). Considering how vulnerable new-borns are to hypothermia, therefore, knowledge of thermal protection among health care providers and mothers is necessary even in tropical countries. This study aimed to determine the prevalence and explore the risk factors associated with neonatal hypothermia in Regional Referral Hospitals in Dar es Salaam through exploration of the knowledge gaps of the WHO recommended guidelines on thermal protection among mothers and healthcare providers in selected referral hospitals.

2. Methodology

2.1 Study Design and Sites

The study was hospital-based descriptive cross-sectional carried out between March and April 2021 at antenatal, labour, and post-natal wards of Mwananyamala and Temeke Regional Referral Hospitals in Dar es Salaam. Dar es Salaam region has four public referral hospitals including Muhimbili National Hospital, Amana, Temeke and Mwananyamala Regional Referrals Hospitals. Numbers were allocated to these public referral hospitals and random sampling was used to select the two referral hospitals. These hospitals have large population catchment areas and easy accessibility.

2.2 Study Population

The study participants included mothers delivered term babies without complications at the study hospitals during the period of study and willing to participate in the study; and all term neonates delivered at the facilities. Pre-term and neonates with complications e.g. congenital malformation were excluded from the study. In determining study population from each hospital, firstly, data on deliveries per month were obtained from each hospital then 296 mother-neonate pairs were selected with proportional to number of deliveries in each hospital. All antenatal, labour, and post-natal ward healthcare providers in the study sites were included in the study. The sample size was calculated according to Kish and Leslie (1965) from which a sample size of 267 neonates would be required to give the study 80% power to detect clinically meaningful results of neonatal hypothermia.

2.3 Data Collection

The study was carried out between 2nd March – 30th May 2021. In order to avoid temperature variation during the day, data was collected from 07: 00 am to 11: 00 pm every day. The Principal Investigator and a trained research assistant conducted separate interviews with the mothers and healthcare workers using questionnaires. The questionnaire was pre-tested among twelve mothers from sites other than the selected health facilities. Information collected from the mothers included age, marital status, occupation, knowledge of the WHO recommendation on neonatal thermal protection. Less than 30 minutes from birth to the time the neonate was weighed and less than 24 hours from birth to the first bath were considered to be early. The researcher physically examined the neonate, measured temperature within 90 minutes post-delivery using a Technocare digital thermometer (Technocare Medisystem Surat, India, accuracy =+-0.1) placed in the axillar; recorded weight and the outcome of delivery

(discharged or admission). All procedures were performed with full adherence to aseptic technique. Hypothermia was regarded present when axillary temperature was less than 36.5 ^{o}C. Neonates with hypothermia were immediately identified and given treatment. Healthcare workers were asked whether they were aware of the WHO recommended steps on the thermal protection and to list them. Data was collected in privacy and confidentiality was assured by using unique identification numbers only known to the principal investigator. Knowledge of the ten WHO Thermal protection guidelines was assessed using a modified Park's criteria (Park, 2011) and the outcome of this study was good or poor knowledge. A score of one point was given for correct answers and zero in the case of wrong or do not know responses. The total knowledge score was calculated by adding the score with a maximum obtainable score of 10 for each participant. Total scores were categorised into two levels, poor knowledge (0–4) while scores of 5 and above were considered good to excellent.

2.4 Statistical Analysis

Data analysis was done using Statistical Package for Social Sciences version 25. Neonatal hypothermia was the dependent variable while independent variables were the Ten Steps of thermal protection of the new-born recommended by WHO (1997) i.e. warm delivery room, skin-to-skin contact, immediate drying, appropriate clothing and bedding, mother and new-born together, breastfeeding, weighing and bathing postponed, warm resuscitation, warm transportation, training and awareness-raising. Frequency tables were used to summarise the major findings. Binary logistic regression equation models were used to determine the correlation between neonatal hypothermia and the independent variables.

2.5 Ethical Considerations

The study was non-invasive therefore, carried minimal risk. The purpose and methods were clearly described to all participants before consent was requested. Only consenting mothers were recruited into the study. The study received ethical clearance from the Hubert Kairuki Memorial University Institutional Review Board and permission to carry out the study in the selected health facilities was obtained from the Hospital Managements. Collected data were handled with strict confidentiality.

3. Results

3.1 Demographic Characteristics of the mothers, New-Born Babies and Health Care Workers

Table 1 shows the characteristics of the study population. A total of 296 mother-new-born pairs were screened for participation in the study out of which 26 (9.6%) did not grant consent, therefore, excluded from the study. Of the remaining neonates 138(51.1%) and 132(48.9%) were selected from Mwananyamala and Temeke Regional Referral Hospitals respectively. Most (52.6%) mothers were aged between 26 and 35 years, and 22.6% were aged 36 and above years. Most mothers (51.9%) had completed primary and lower-level education; 80 (29.6%) had secondary level education and 50 (18.9%) had post-secondary were. Married women accounted for 86.7%, majority 165 (61.1%) were housewives. Mothers 248 (91.9%) were not aware of the thermal protection requirement (inadequate knowledge) and only 8.9% had the knowledge.

3.2 Neonates

There were 161 (59.6%) and 109 (40.4%) female and male neonates and majority had normal birth weight (>2.5–4.3 kgs). Thirteen neonates (4.8%) had low birth weight. Majority (97.0%) of the neonates were healthy therefore, discharged uneventfully while eight (3.0%) were admitted for further care due various reasons including birth asphyxia (2), small for gestation age (1), fever (2) and large babies (3).

3.3 Health Care Workers

A total of 41 health care workers worked in the neonatal care facilities in the two hospitals. 17(41.5% were doctors and the remaining were of the nursing cadre. Majority (96.5%) were holders of diploma and first degrees with only one specialist paediatrician. Majority (31.7%) of the nursing staff were in the category of nursing officers while 4(9.8%) were nurse midwives.

Table 1. Demographic characteristics of the mothers, new-born babies and health care workers in delivery rooms and neonatal wards in Mwananyamala and Temeke referral hospitals in Dar es Salaam, Tanzania

Description	Frequency	%
Mother's age		
15–25	67	24.8
26–35	142	52.6
> 36	61	22.6
Mother's education level		
Primary	140	51.9
Secondary	80	29.6
Post-secondary	50	18.5
Marital status		
Married	234	86.7
Never married	36	13.3
Occupation		
Employed	12	4.4
Self employed	93	34.4
Housewife	165	61.1
Mother's Knowledge of thermal protection		
Adequate	22	8.1
Inadequate	248	91.9
Newborn characteristics		
Male	109	40.4
Female	161	59.6
Birth weight gm		
< 2500	13	4.8
2600–3700	108	40.0
> 3700	96	35.6
Outcomes		
Discharged	262	97.0
Admitted	8	3.0
Health care workers education level education		
Masters	1	2.4
UG Degrees	18	43.9
Diploma	22	53.7
Cadre of the health care provider		
Specialist doctors	1	2.4
Medical doctors	16	39.0
RNO	5	12.2
ANO	8	19.5
Enrolled Nurse	7	17.1
Nurse Midwife	4	9.8

RNO = Registered Nursing Officer, ANO stands for Assistant Nursing Office and UG stands for undergraduate.

3.4 Healthcare Worker's Knowledge on Thermal Protection of the New-Born

Table 2 shows that while the knowledge of appropriate clothing and bedding was known by 37 (90.2%) of the healthcare providers, majority did not know the rest of the Ten Steps of WHO recommended thermal protection guidelines. Knowledge on the need for the baby to be close to the mother, immediate drying and breast feeding within an hour was inadequate. Also, some steps such as delayed bathing, warm resuscitation and warm transport were not mentioned.

Table 2. The knowledge of the WHO recommended thermal protection practices among health care providers in Mwananyamala and Temeke referrals hospitals in Dar es Salaam, Tanzania

Description of WHO Thermal protection	**Knowledge status**				
	Adequate	%	Inadequate	%	p-value
Warm delivery room	2	4.9	39	95.1	0.065
Skin to skin contact	13	31.7	28	68.3	0.000*
Immediate drying	1	2.4	40	97.6	0.365
Appropriate clothing	37	90.2	4	9.8	0.013*
Mother to newborn together	1	2.4	40	97.6	0.005*
Breast feeding within an hour	2	4.9	39	95.1	0.065
Training awareness	3	7.3	38	92.7	0.054

**Significant p – values.*

3.5 Prevalence of Neonatal Hypothermia

Table 3 shows that out of 270 neonates, 69 (25.6%) were hypothermic within 90 minutes post-delivery. Of the neonates who were hypothermic, mild and moderate hypothermic states were seen in 38 (14.1%) and 31 (11.5%) of the neonates respectively. No neonates had developed severe hypothermia.

Table 3. The prevalence of neonatal hypothermia within 90 minutes of life in Mwananyamala and Temeke referral hospitals in Dar es Salaam, Tanzania

Variable	**Frequency**	**Percent**
Normal temperature	201	74.4
Mild hypothermia	38	14.1
Moderate hypothermia	31	11.5
Severe hypothermia	0	0
Total	**270**	**100**

3.6 Factors Associated with Neonatal Hypothermia

The results of binary logistic regression (Table 4) shows that inadequate knowledge of skin-to-skin contact between the mother and new-born significantly correlated with hypothermia and has increased Odd's ratio for hypothermia (AOR=2.160, 95% CI 0; 0.99-5.66; p = 0.024) and immediate weighing and bathing of the new born baby significantly correlated with hypothermia (COR = 0.88; 95%CI, 11–2.43; p = 0.05).

Table 4. The factors associated with hypothermia among neonates born in Mwananyamala and Temeke referral hospitals in Dar es Salaam, Tanzania

Description of variables (n = 270)	Body temperature 90 min postdelivery				COR (95% CI)	p-value	AOR (95% CI)	p-value
	Hypothermia	%	No hypothermia	%				
Skin-to-skin contact								
Yes	59	29.1	144	70.9				
No	10	14.9	57	85.1	0.43(1.12–4.88)	0.02*	2.16(0.99-5.66)	0.05*
Thoroughly dried								
Yes	66	25.2	196	74.8				
No	3	37.5	5	62.5	0.561(0.13–2.41)	0.684	0.40(0.08-1.93)	0.25
Appropriate clothing								
Yes	66	26.8	180	73.2				
No	3	12.5	21	87.5	2.567(0.74–8.89)	0.147	2.32(0.64-8.39)	0.2
Mother and Baby together								
Yes	61	27.5	161	72.5				
No	8	16.7	40	83.3	1.894(0.84–4.28)	0.15	1.25(0.47-3.31)	0.66
Breastfeeding within an hour								
Yes	49	27.5	129	72.5				
No	20	21.7	72	78.3	1.37(0.75–2.48)	0.38	1.15(0.61-2.17)	0.68
Appropriate clothing								
Yes	66	26.8	180	73.2				
No	3	12.5	21	87.5	2.567(0.74–8.89)	0.147	2.32(0.64-8.39)	0.2
Weighing and bath postponed								
Yes	19	34.5	36	65.5				
No	50	23.3	165	76.7	0.88(0.11-2.43)	0.05*	1.25(0.48-0.73)	0.31*
Warm transportation								
Yes	0	0.00	0	0.00				
No	69	25.6	201	74.4				

4. Discussion

Radiation, convection, conduction and evaporation of the amniotic fluid from the skin the new-born baby are major mechanisms through which neonates lose heat from the body. Neonates are at risk of hypothermia because of their large surface area to body mass and pre-term babies are even more at risk because of minimal subcutaneous fat stores, low body tone and limited capacity to generate heat from fat stores (Beers, Fletcher, Jones, Porter, Berkwitz, & Kaplan., 2003). The prevalence of hypothermia in this study was 25.6%, similar to the results in a study in Rwanda which assessed the prevalence and risk factors for neonatal hypothermia on admission into a tertiary neonatal unit (Choi, Urubuto, Dusabimana, Agaba, & Teteli., 2019). Several factors have been used to explain the differences in the prevalence of hypothermia between studies including methodologies, time at temperature measurements and socio-cultural factors (Nyandiko, Kiptoon, & Lubuya, 2021). In this study, axillary temperature measured within 90 minutes post-delivery was used to assess hypothermia post-delivery in a delivery room whose temperature ranged between 25 and 28 ^{o}C. The measurement method and the warm environment could explain the low prevalence of hypothermia compared 67.6% reported among neonates within 72 hours of hospitalisation (Ogunlesi, Ogunfowora, & Ogundeyi., 2009). Our finding, therefore, supports the WHO recommendation (2017) of the need to ensure a warm delivery room in the protection of neonates from developing hypothermia.

We found inadequate knowledge of thermal protection among mothers and healthcare workers which is in agreement with a report in Ethiopia which found only 33.5% of the 510 mothers had good knowledge of the essential new-born care (Getachew, Dheresa, Eyeberu, Balis, & Yadeta, 2020). The low knowledge in some communities would be associated with cultural beliefs e.g. beliefs that skin- to- skin contact with the mother could hurt the umbilical cord and transmit diseases from the mother to the neonate (Waiswa, Peterson, Tomson, & Pariyo, 2010; Byaruhanga, Nsungwa-Sabiit, Kiguli, Balyeku, Nsabagasani, & Peterson, 2011). Although it has been reported that immediate washing is associated with reduction of neonatal body temperature (Gunnlaugsson, Da Silva, & Smedman 1992; WHO, 1997), washing of the new-born soon after birth is common practice in some communities globally. In West Africa, some societies believe that immediate washing provides the neonate with good sleep and rest (Adejuyigbe, Bee, Amare, Omotaran, Ignus et al., 2015). We found a significant association between early weighing and bathing with hypothermia. Out of the 61 neonates who had early bathing 27.1% were found to be hypothermic as compared to 16.7% of neonates with delayed washing had hypothermia. The practice of washing neonates shortly after birth has been explained by beliefs that the contact with maternal fluids during delivery contaminates the new-born, therefore, should immediately be washed (Waiswa, Kemigisa, Kiguli, Naikoba, Pariyo, & Peterson, 2008; Shamba et al., 2014).

The knowledge on the need for early bonding between the neonate and the mother through breast feeding was in this study inadequate and significantly associated with increased risks for neonatal hypothermia. We did not explore why a newborn baby should not be breastfed soon after birth but reports show that between 15 and 65% of mothers studied in different regions of the world had delayed breastfeeding of their babies (Omotola & Akinyele, 1985; Osrin, Tumbahangphe, Shreshta, Mesko et al., 2002). In, Nigeria, mothers claimed to have discarded colostrum in the first 24 hr postpartum and infants were fed on glucose water or herbal preparations (Omotola & Akinyele, 1985). Reports from Guinea-Bissau and Uganda suggest that mothers had negative cultural perceptions about colostrum and some communities believe that colostrum is dirty milk and mothers delay feeding to allow the milk to clear (Gunnlaugsson, Da Siva, & Smedmann, 1992; Mukunya, Tumwine, Nankabirwa, Odongkara, Arach et al., 2021).

In 1997, the WHO recommended the warm chain strategy to prevent neonatal hypothermia, now over four decades, still the knowledge and application of the guidelines is low and there are negative attitudes towards early breast feeding. These practices have in some communities negatively influenced application of the recommended warm chain strategy. This calls for a wider study to assess availability and application of the WHO Guidelines at health facilities in the country; and to develop implementable strategies to revamp awareness and knowledge of the mothers and health care providers on the tool.

5. Conclusions

The findings in our study show a high prevalence of neonatal hypothermia and suggest gaps on the knowledge of thermal protection of new-born among mothers and healthcare providers. It is recommended that further studies be carried out to determine availability and application of the WHO Guidelines at the health facilities.

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Author's Contribution

MA developed the proposal concept and did most of the writing. LM, AK, FSK, FM and MF participated in ensuring the proposal was sound, ethical clearance granted and supervised the Principal Investigator. EM and YM ensured effective supervision, read and edited the manuscript several times and facilitated submission for publication.

Competing Interests Statement

All authors have declared o conflict of interest on any part of the proposal and study.

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