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CHARACTERISTICS OF NEWBORNS WITH SURGICAL CONDITIONS, REFERRED TO AND SEEN AT A TERTIARY LEVEL HOSPITAL IN WESTERN KENYA
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# CHARACTERISTICS OF NEWBORNS WITH SURGICAL CONDITIONS, REFERRED TO AND SEEN AT A TERTIARY-LEVEL HOSPITAL IN WESTERN KENYA

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## ABSTRACT

*Background:* **World over, neonatal mortality contributes significantly to the under-five mortality rate, and 10% of neonatal deaths in low and middle-income countries (LMICs) are due to surgical conditions. The majority of surgical conditions are congenital malformations that are only amenable to surgical treatment in the neonatal period. In Kenya, specialized neonatal surgical care is only available in the two tertiary level hospitals in Eldoret and Nairobi. Since the majority of newborns with surgical conditions are born or seek initial care in the lower level health facilities, appropriate referral and transport to the tertiary-level hospitals determines the overall outcome of their treatment. Moreover, socio-demographic and clinical characteristics of newborns with surgical conditions are important determinants of the outcome of their care at the tertiary-level hospital.**
*Study Objective:* **To describe the socio-demographic; clinical; and referral and transport characteristics of the newborns with surgical conditions, who were referred to and seen at Moi Teaching and Referral Hospital (MTRH).**
*Study design:* **A hospital-based cross-sectional study was done on all newborns with surgical conditions referred, transported to and seen at the Newborn Unit.**
*Study Setting:* **Moi Teaching and Referral Hospital, Eldoret, Kenya.**
*Main Outcomes:* **Socio-demographic; clinical; and referral and transport characteristics of the newborns who met the inclusion criteria.**
*Results:* **One-hundred and twenty-six newborns who met the inclusion criteria were recruited into the study between February 2018 and January 2019. The median age of the newborns at admission was 4.4 days (106.5 hours), and only 26 (20.6%) of their mothers had optimal antenatal care during pregnancy. The level of education and the occupation of their mothers had a significant association with the uptake of antenatal care during pregnancy (p-value = 0.000). The**

**majority had congenital anomalies that were mainly gastroschisis (23.0%), hydrocephalus (18.3%), ano-rectal malformations (ARM) (14.3%) and Hirschsprung's disease (14.3%). Most (96.0%) of the newborns were transported to MTRH using road ambulance, and 95.2% were escorted by trained medical personnel during transport.**

***Conclusions:*** **Congenital anomalies were the major surgical conditions seen in the newborns referred and transported to MTRH, and gastroschisis was the leading condition. The newborns had delay in accessing neonatal surgical care; and the majority of their mothers had poor antenatal care during pregnancy, despite the apparent high health-facility delivery.**

## INTRODUCTION

Maternal and neonatal health is an important public health issue both nationally and globally as enshrined in the World Health Organization (WHO)'s fourth Millennium Development Goal[1]. Neonatal mortality accounts for between 35% and 50% of the under-five mortality rates in low- and middle-income countries (LMICs), mainly in Asia and Africa[2]. Moreover, 9% of global disease burden is attributed to congenital malformations[3]. In sub-Saharan Africa, 2.6 million children are born with congenital malformations[4]. Many of these malformations are only amenable to surgery in the neonatal period, which in Kenya is only feasible in the two tertiary level hospitals in Eldoret and Nairobi. Many of these newborns are born and/or seek initial care in health facilities that have no capacity to treat their conditions hence, the need for appropriate referral and transport[5].

Previous hospital-based studies have indicated that improper referral and inter-facility transport of newborns with surgical conditions contribute significantly to the overall neonatal mortality[6,7,8]. These deaths are often attributed to a three-delay model, the delay in recognition of the severity of the illness, the delay in seeking and accessing care, and the delay in the provision of care once at the health facility[9]. This 3-delay model was developed by *Thadeus and Maine* while exploring the causes of maternal deaths, and initially comprised the delay in deciding to seek care (delay 1), the delay in reaching the health care facility (delay 2), and delay in receiving quality care once at the health care facility (delay 3)[10]. The model has been explored in analyzing perinatal deaths in LMICs and found to be useful[11,12].

Several studies have linked various characteristics of newborns referred to tertiary level hospitals for specialized care, and the outcomes of their treatment. Sachan *et al*, Narang *et al* and Aggarwal *et al* reported an inverse relationship between mortality of referred newborns, and their gestational age, birthweight and delivery conducted by unskilled birth attendant[13,14,15].

Whereas the exact contribution of neonatal referral and transport characteristics to neonatal mortality is unknown, a few studies have reported mortality rates of 25 – 35% in sick newborns transported to tertiary level hospitals[16]. Currently, there is limited research, particularly in resource limited settings like Kenya, which focuses on appropriate transport of newborns with surgical conditions.

This study laid focus on the delay in seeking and accessing newborn surgical care, and sought to describe the socio-demographic; clinical; and referral and transport characteristics of the newborns with surgical conditions that were referred, transported to, and seen at Moi Teaching and Referral Hospital (MTRH), for specialized surgical care.

## MATERIALS AND METHODS

*Study design and Study Population:* This was a descriptive cross-sectional study that was nested in a wider quasi-experimental study design. The study population was all newborns with surgical conditions referred to and seen at the Newborn Unit of the Moi Teaching and Referral Hospital (MTRH).

*Study Setting:* The study was conducted in the Newborn Unit of the MTRH, which is located in Uasin Gishu County in the North Rift Region of western Kenya. Moi Teaching and Referral Hospital, the second tertiary-level hospital in Kenya, serves the greater western Kenya, with an approximate population of 16.2 million. Its Newborn Unit receives referrals from over 20 county referral hospitals in the region, and approximately 30% of the referred newborns seek surgical care[17].

*Variables:* The variables were socio-demographic; clinical; and referral and transport characteristics.

*Sampling, Data Collection, and Data Analysis:* All newborns with surgical conditions, referred from 10 selected county referral hospitals during the study period (February 2018 – January 2019) were recruited into the study. The 10 hospitals were selected, out of 20 county referral hospitals that refer newborns with surgical conditions to MTRH, by random cluster sampling. A pre-tested data collection tool was used to record data on the study variables. Data were collected by review of medical records, and interviews of the transport teams which were done immediately after the newborns were handed over to the Newborn Unit. Data was entered into STATA version 11 and analyzed using descriptive statistics. Fisher's Exact Test was used to test associations between study variables and $P < 0.05$ was considered statistically significant.

*Ethical Considerations:* The study protocol was fully explained to the parents/guardians and the transport teams; and informed consent was obtained. Ethical approval was sought from and granted by Moi University-MTRH Institutional Research Ethics Committee.

## RESULTS

One hundred and twenty-six (126) newborns, with surgical conditions, were recruited into the study during the study period (February 2018 to January 2019).

*Socio-demographic characteristics of the newborns with surgical conditions*. The median age at admission was 106.5 hours, (IQR = 77,133), which was approximately 4.4 days. Their median birth weight was 2700g (IQR = 2200, 3200), and the Male to Female ratio was 1:1. The median maternal age was 23 years and the majority (93.7%) of their mothers had formal education. (See Table 1).

**Table 1**
*Socio-demographic Characteristics of the Newborns*

| **Variable** | |
|---|---|
| **Age at admission** (Hours) | N = 126 |
| Median (IQR) | 106.5 (77, 133) |
| **Birth Weight** (Grams) | N = 126 |
| Median (IQR) | 2700 (2200, 3200) |
| **Weight at admission** (Grams) | N = 126 |
| Median (IQR) | 2617.5 (2140, 3020) |
| **Maternal Age** (Years) | N = 126 |
| Median (IQR) | 23 (20,28) |
| **Maternal Level of Education** | N = 126 |
| Non-formal (%) | 8 (6.3) |
| Primary (%) | 47 (37.3) |
| Secondary (%) | 50 (39.7) |
| Tertiary (%) | 21 (16.7) |
| **Maternal Occupation** | N = 126 |
| No Employment (%) | 80 (63.5) |
| Self-Employment (%) | 28 (22.2) |
| Formal Employment (%) | 18 (14.3) |

*Clinical Characteristics of the newborns with surgical conditions:* Forty-Six (36.5%) mothers of the recruited newborns did not seek antenatal care during pregnancy. Of the 80 (63.5%) who sought antenatal care, only 26 (20.6) had > 3 antenatal visits. Thirty-Nine (30.9%) mothers had antenatal ultrasound scans done during the antenatal visits that only detected congenital anomalies in 9 (23.1%). The majority (90.5%) of the newborns referred with surgical conditions were born in health facilities, by normal vaginal delivery (88.9%). Eighty-nine-point seven percent of the deliveries were assisted by skilled birth attendants (See Table 2).

**Table 2**

*Clinical Characteristics of the Newborns*

| **Variable** | |
|---|---|
| **Gestational Age** (Weeks) | N = 126 |
| Preterm (< 37), (%) | 48 (38.1) |
| Term (≥ 37) (%) | 78 (61.9) |
| **Antenatal Care Visits** | N = 126 |
| None (%) | 46 (36.5) |
| < 3 (%) | 54 (42,9) |
| ≥ 3 (%) | 26 (20.6) |
| **Antenatal Ultrasound Scan** | N = 80 |
| Yes (%) | 39 (48.8) |
| No (%) | 41 (51.2) |
| **Trimester of Ultrasound Scan** | N = 39 |
| 1st (%) | 5 (12.8) |
| 2nd (%) | 21 (53.8) |
| 3rd (%) | 13 (33.3) |
| **Congenital anomaly detected** | N = 39 |
| Yes (%) | 9 (23.1) |
| No (%) | 30 (76.9) |
| **Place of Birth** | N = 126 |
| Home (%) | 12 (9.5) |
| Private hospital (with Skilled Birth Attendant) (%) | 9 (7.1) |
| Dispensary (%) | 23 (18.3) |
| Health Centre (%) | 7 (5.6) |
| Sub-County hospital (%) | 34 (27.0) |
| County hospital (%) | 41 (32.5) |
| **Mode of delivery** | N = 126 |
| Normal vaginal delivery (%) | 112 (88.9) |
| Caesarean Section (%) | 14 (11.1) |
| **Personnel Conducting Delivery** | N = 126 |
| Non-Skilled Birth Attendant (%) (TBA, family or neighbor) | 12 (9.5) |
| Skilled Birth Attendant (%) (doctor, nurse or nurse-midwife) | 114 (90.5) |

*Spectrum of surgical conditions seen in newborns referred to MTRH:* The majority of the newborns who were referred and transported to MTRH had congenital anomalies (See Figure 1). The top 4 surgical conditions were gastroschisis (23.0%), hydrocephalus (18.3%), ano-rectal malformations (ARM) (14.3%) and Hirschsprung's disease (14.3%).

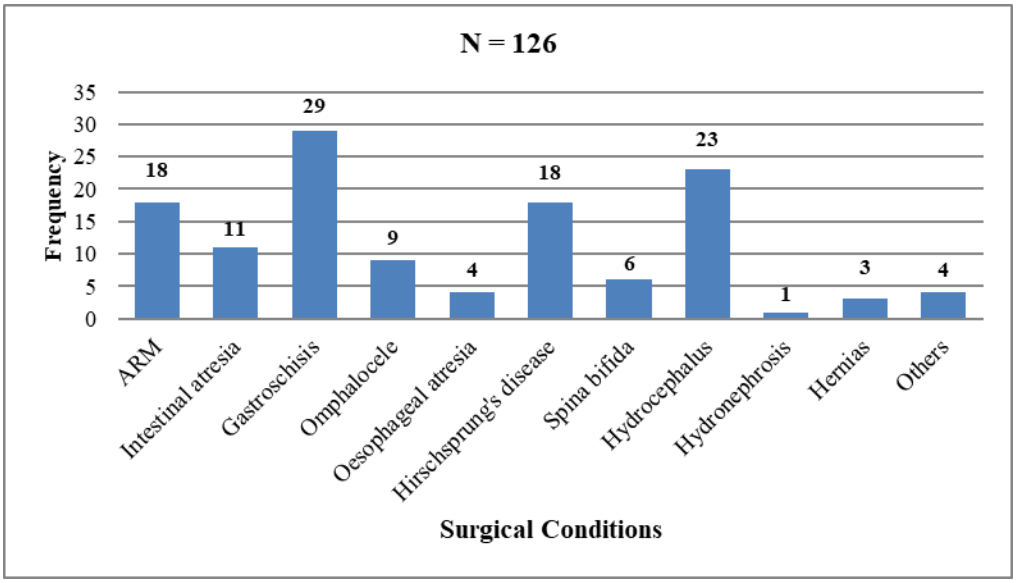


**Figure 1: Spectrum of surgical conditions of newborns referred to and seen at MTRH.**

*Referral and Transport characteristics of the newborns with surgical conditions:* Most (96.0%) of the newborns were transported to MTRH using road ambulance, and 95.2% were escorted by trained medical personnel during transport (See Table 3).

**Table 3**

*Referral and Transport Characteristics of the Newborns*

| Variable | |
|---|---|
| **Mode of Transportation** | N = 126 |
| Road Ambulance (%) | 121 (96.0) |
| Public Motor Vehicle (%) | 5 (4.0) |
| **MTRH Contacted before Referral** | N = 126 |
| Yes (%) | 115 (91.3) |
| No (%) | 11 (8.7) |
| **Mode of Communication on Referral** | N = 126 |
| Written (%) | 113 (89.7) |
| Verbal (%) | 2 (1.6) |
| None (%) | 11(8.7) |
| **Escort during Transport** | N = 126 |
| Trained Medical Personnel (%) | 120 (95.2) |
| Parent/Guardian (%) | 6 (4.8) |

*Association between socio-demographic and clinical characteristics of the newborns with surgical conditions.* The level of education and the occupation of the mothers had a statistically significant association with their antenatal clinic visits during pregnancy (p-value = 0.001). (See Table 4)

**Table 4**

*Association between Socio-demographic and Clinical Characteristics of Newborns*

| Variable | Antenatal Care Visits Frequency (%) | | | p-value |
|---|---|---|---|---|
| | **None** | **< 3** | **≥ 3** | |
| **Maternal Level of Education** | N = 126 | | | |
| Non-formal | 8 (100) | 0 (0.0) | 0 (0.0) | |
| Primary | 19 (40.4) | 23 (48.9) | 5 (10.6) | |
| Secondary | 16 (32.0) | 22 (44.0) | 12 (24.0) | **0.001*** |
| Tertiary | 3 (14.3) | 9 (42.9) | 9 (42.9) | |
| **Maternal Occupation** | N = 126 | | | |
| No Employment | 40 (50.0) | 30 (37.5) | 10 (12.5) | |
| Self-Employment | 6 (21.4) | 18 (64.3) | 4 (14.3) | **0.001*** |
| Formal Employment | 0 (0.0) | 6 (33.3) | 12 (66.7) | |

*Fisher's Exact Test *statistically significant*

## DISCUSSION

In this audit, which was nested within a quasi-experimental study that attempts to determine the effect of introducing a structured standard operating procedure for transport of newborns with surgical conditions in western Kenya, we describe the socio-demographic; clinical; and referral and transport characteristics of the newborns with surgical conditions, who were referred and transported to a tertiary-level hospital for specialized surgical care. These characteristics often determine the newborns' treatment outcomes at the tertiary-level hospital. Improper transport of the newborns during referral has been found to be a major contributor to neonatal mortality usually at the second level of the 3-delay model[11,12].

The median age at admission of 106.5 hours (4.4 days) suggests a delay in accessing neonatal surgical care. Barriers to care-seeking as characterized by the 3-delay model could explain this delay. This model that comprises the delay in deciding to seek care (delay 1), delay in reaching the health care facility (delay 2), and delay in receiving quality care once at the health care facility (delay 3), has been found to be useful in analyzing perinatal deaths in LMICs[11,12]. In this study, there is delay in accessing neonatal surgical care despite the majority (90.5%) of the newborns being born in health facilities. Studies done in Middle-Income-Countries (MICs) reported lower median ages at admission[18,19], further suggesting socio-economic status as an important determinant of delay to seek care. The median birth weight of 2700g was similar to those found in other studies[20,21].

The majority (61.9%) of the newborns transported to MTRH with surgical conditions were term, a finding that was similar to other studies in LMICs. Studies done in India reported varied proportions of

term newborns that ranged from 40.0% to 78.5%[13,20,21,22]. This may further suggest that congenital anomalies that form a large proportion of surgical conditions of the referred newborns is often associated with preterm deliveries.

On the place of delivery, we found that only 9.5% were delivered at home, which was comparable to that reported in other studies, that ranges between 10.5% and 24.0%[12,13,19,20]. This could perhaps be part of the fruits of the global efforts in formulation and implementation of strategies that increase deliveries in health facility[23]. Demographic and Health Surveys (DHS) in Sub-Saharan Africa and Asia have shown that more than 75% of women combined in both regions now deliver in health facilities[24]. In this study, 90.5% of the newborns were delivered in health facilities compared to the 66.1% overall health facility deliveries in Kenya[25], and the 56.9% that was reported in a similar study in Nigeria[19]. The high proportion of health facility deliveries found in this study could perhaps suggest that most of the mothers may have had pregnancy complications that necessitated health facility delivery.

The study further reports a young median maternal age that may perhaps be related to the spectrum of neonatal surgical conditions. The majority (98.8%) of the neonatal surgical conditions were congenital anomalies, with the leading anomalies being gastroschisis, neural tube defects, anorectal malformations and Hirschsprung's disease. Ikol *et al* reported a similar spectrum in a study on the outcomes of neonatal surgery[17]. Young maternal age has been reported to have an association with gastroschisis and neural tube defects[26,27]. Despite the fact that the majority (93.7%) of the mothers had formal education, 63.5% were unemployed and a further 22.2% were self-employed. Low socio-economic status contributes to the first and second levels of delays in the 3-delays model that leads to high neonatal mortality[12].

In this study, 80 (63.5%) mothers had some antenatal care, but only 26 (20.6%) had the recommended optimal antenatal visits during pregnancy. However, there was a statistically significant association between maternal level of education and occupation; and antenatal care visits during pregnancy. These findings were similar to those by Gitonga *et al*, who found maternal age, level of education and occupation to be the major determinants of uptake of focused antenatal care[28]. Similarly, they noted that maternal age below 20 years was associated with least uptake, and that women with formal employment had higher uptake.

During these antenatal visits, antenatal ultrasound scan was done in 39 (48.8%) mothers, and congenital anomalies were only detected in 9 (23.1%). Goldsmit *et al* reported similar findings in Argentina[18]. Onyambu *et al* reported the detection of congenital fetal anomalies on routine antenatal ultrasound screening of low-risk pregnancy, at a rate of 3%[29]. Evidence-based policies developed by the WHO have suggested that early antenatal ultrasound scans may increase the detection of congenital anomalies[30]. In view of the WHO's recommendation of routine early (< 24 weeks) antenatal ultrasound in pregnancy, the finding that the majority of the antenatal ultrasound scans were done in the 1st trimester (12.8%) and 2nd trimester (53.8%) is pivotal, and could perhaps explain the apparently higher detection rate of congenital anomalies on antenatal ultrasound.

We further report that the majority (88.9%) of the newborns with surgical conditions were born via normal vaginal delivery, which were conducted majorly (90.5%) by skilled birth attendants. This further conforms to the

finding that the majority of the newborns were delivered in health facilities, which are obviously manned by skilled birth attendants. Sachan *et al* and Upadhyay *et al* had similar findings in studies done in India[13,20].

The majority (96.0%) of the newborns with surgical conditions, who were referred to MTRH, were transported by road ambulance. The ushering in of devolved system of government in Kenya following the enactment of the new constitution in 2010 enabled many counties to procure road ambulances as part of equipping their county health systems. Prior to this, Mwai *et al* reported that the number of road ambulances per hospital in Kenya was at 0.06 – 3.63[31]. This could perhaps explain the finding in this study, that is similar to that reported is a study done in India[21]. In the contrary, a study done in Nigeria reported the use hospital ambulances at a paltry 4%[19].

This study further demonstrated that prior to the referral and transport of newborns with surgical conditions, appropriate communication was made in the majority (89.7%) of the cases, perhaps indicating the effect of referral strategies that were initiated by the Ministry of Health in 2014[32]. Only 6 (4.8%) newborns had inappropriate escort during transport. This was contrary to a similar study in India that reported that appropriated communication to the referral hospital prior to referral was done in 28% of the newborns, and a further 55.7% had inappropriate escort during referral and transport[33].

## CONCLUSION AND RECOMMENDATION

Congenital anomalies were the major surgical conditions seen in the newborns referred and transported to MTRH, and gastroschisis was the leading condition. The newborns had delay in accessing neonatal surgical care, and the majority of their mothers had poor antenatal care during pregnancy, despite the apparent high health-facility delivery. The majority of the newborns had appropriate mode of transportation and adequate pre-referral communication from the referring health facility.

We recommend a systematic analysis of perinatal surgical morbidity and mortality using a simple 3-delay methodology that would perhaps determine the causes of delay in access to neonatal surgical care despite the majority of the newborns with surgical conditions being born in health facilities, and used the road ambulance as their main mode of transportation.

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