How do low-birthweight neonates fare 2 years after discharge from a low-technology neonatal care unit in a rural district hospital in Burundi?

W. van den Boogaard[1], I. Zuniga[2], M. Manzi[1], R. Van den Bergh[1], A. Lefevre[2], K. Nanan-N'zeth[3], B. Duchenne[3], W. Etienne[2], N. Juma[4], B. Ndelema[4], R. Zachariah[1] and A. Reid[1]

1 Médecins Sans Frontières, Brussels Operational Centre – Operational Research Unit (LuxOR), Luxembourg City, Luxembourg
2 Médecins Sans Frontières, Brussels Operational Centre, Brussels, Belgium
3 Médecins Sans Frontières, Bujumbura, Burundi
4 Ministry of Health, Bujumbura, Burundi

Abstract

OBJECTIVES As neonatal care is being scaled up in economically poor settings, there is a need to know more on post-hospital discharge and longer-term outcomes. Of particular interest are mortality, prevalence of developmental impairments and malnutrition, all known to be worse in low-birthweight neonates (LBW, <2500 g). Getting a better handle on these parameters might justify and guide support interventions. Two years after hospital discharge, we thus assessed: mortality, developmental impairments and nutritional status of LBW children.

METHODS Household survey of LBW neonates discharged from a neonatal special care unit in Rural Burundi between January and December 2012.

RESULTS Of 146 LBW neonates, 23% could not be traced and 4% had died. Of the remaining 107 children (median age = 27 months), at least one developmental impairment was found in 27%, with 8% having at least five impairments. Main impairments included delays in motor development (17%) and in learning and speech (12%). Compared to LBW children ($n = 100$), very-low-birthweight (VLBW, <1500 g, $n = 7$) children had a significantly higher risk of impairments (intellectual – $P = 0.001$), needing constant supervision and creating a household burden ($P = 0.009$). Of all children (n-107), 18% were acutely malnourished, with a 3½ times higher risk in VLBWs ($P = 0.02$).

CONCLUSIONS Reassuringly, most children were thriving 2 years after discharge. However, malnutrition was prevalent and one in three manifested developmental impairments (particularly VLBWs) echoing the need for support programmes. A considerable proportion of children could not be traced, and this emphasises the need for follow-up systems post-discharge.

keywords low-birthweight neonates, developmental impairments, malnutrition, sub-Saharan Africa, operational research

Introduction

Neonatal mortality rates (NMR) account for 40% of all under-five mortality and are therefore an important challenge to the newly set Sustainable Development Goal (SDG 3) targets for neonatal mortality aimed at achieving <12 deaths per 1000 live births by 2030 [1].

The leading cause of neonatal death is related to prematurity (<37 weeks gestation) and its complications [2]. Low-birthweight (LBW; <2.5 kg), neonatal infection (including sepsis), and intrapartum events are other main factors associated with neonatal mortality in resource-limited settings [3]. Neonates with such factors are also more prone to manifest long-term adverse outcomes such as

cerebral palsy, cognitive problems, and other neurodevelopmental disabilities [4]. Such adverse outcomes are inversely correlated with gestational age and birthweight [5–7].

A systematic review by Milner et al. reported a 21% prevalence of neurodevelopmental impairments for survivors of pre-maturity/very-low-birthweight (VLBW), although study populations and outcome measures were very heterogeneous [8]. Data are lacking, or sparse and of poor quality, as discussed by Lawn et al. in the Born to Soon series: Care for the preterm baby [7]. As neonatal care is being scaled up in resource-limited settings, there is a need for better reporting on evidence-based neonatal care, and to know more about the incidence of adverse long-term outcomes [4, 9]. In low-resource

settings, this is particularly important as the consequences of developmental impairments/disability are likely to be worse, and support options for affected families remain insufficient or unavailable. LBW has also been associated with higher risk of acute and chronic malnutrition [10]. Besides the studies mentioned, there is very little literature on longer-term outcomes of pre-term and LBW neonates from resource-poor settings, and particularly from sub-Saharan Africa.

In rural Burundi, we previously described an effective model for delivering emergency obstetric and neonatal care (EmONC) using low-technology and non-specialised staff [11–14]. This model was introduced by Médecins Sans Frontières (MSF) in a rural district (Kabezi) to provide care for LBWs [11–14]. A better understanding of the prevalence and typology of developmental impairments in this setting would help justify and guide appropriate support programmes.

We used this opportunity to determine the outcomes of LBW neonates 2 years after they were discharged from a neonatal special care unit (NSCU). Specific objectives were to determine: (i) mortality during those 2 years; (ii) the types of sequelae: impairments of motor and cognitive development, vision and hearing; (iii) the potential burden to the family in caring for LBW children; and (iv) their nutritional status.

Methods

Population and design

The study population included all LBW neonates who were discharged during the year 2012 following admission to the NSCU or Kangaroo Care Unit (KCU) at Kabezi EmONC Centre, and who resided in Bujumbura Rural province. This was a prospective household survey using a semistructured questionnaire, including a '10 questions screening' tool for the detection of disabilities or impairments.

General setting

This study was performed in Kabezi district in Bujumbura Rural Province, Burundi, between August and November 2014. Health outcomes are very poor in Burundi; the under-five mortality rate (U5MR) in 2015 was 82 per 1000 live births, and the neonatal mortality rate (NMR) 29 per 1000 live births [15]. Maternal and child care are offered free of charge, but access to quality-specialised neonatal care in Burundi is extremely scarce, as there are only three public intensive neonatal care units and five paediatricians for all neonatology services in the whole country, all based in the capital.

Specific setting – EmONC and neonatal care

The study site was Kabezi District hospital in Kabezi town, 17 km from Burundi's capital, Bujumbura. Tayler-Smith *et al.* [11, 12] have described in depth MSF's EmONC services including its referral system, while Zuniga *et al.* [13] and Ndelema *et al.* [14] provided an overview of the capacity of its neonatal care. Its human resources included one doctor (GP), two nurses, and one nursing assistant, 24 h/24 and one nurse supervisor during the day, all of whom were trained by a paediatrician. In brief, neonates admitted to the NSCU were treated following specific protocols for the most common neonatal pathologies. Those needing birth resuscitation (bag and mask ventilation with or without cardiac massage) were resuscitated in the delivery room prior to transfer to the NSCU. Surfactant therapy was not available. Other than oxymeters, oxygen concentrators, perfusion pumps and heated mattresses, no biomedical machines such as ventilation support (invasive or non-invasive), phototherapy machines or incubators were available. Hearing screening, ophthalmological evaluations or brain ultrasound examinations were not performed during the hospital stay. In 2012, the EmONC centre had a bed capacity for 17 neonates in special care, and five in Kangaroo Care (KCU). Neonates admitted to the KCU were LBW and/or pre-mature neonates without any pathology and only in need of assistance in feeding and keeping warm until a weight of 2500 g was reached. Feeding assistance consisted of nasogastric tube feeding, spoon and cup feeding and support for breastfeeding, according to need. Neonates received expressed mother's milk whenever possible. A few newborns were supplemented with pre-mature infant formula (when mother's milk was not available). Human milk fortification was not available. Neonates were transferred from NSCU to the KCU (and vice versa) depending on their weight or changes in illness status. Few neonates were transferred to a neonatal intensive care unit in the capital, as often there was no space available or those units did not have the capacity to deal with the pathology. After discharge from hospital no routine follow-up was provided.

Prospective household follow-up of infants after discharge from NSCU or KCU

Data related to the study objectives were extracted from a dedicated EmONC e-database which used unique patient identity numbers for the mothers and their newborns. This e-database was cross-checked with clinical files for data validation. A line-list was created for the eligible patients, and the mothers' patient files were used for identifying the geographical addresses.

Two nurses who were knowledgeable in paediatric care and speaking Kirundi – the local language – were selected and trained as interviewers. The 'Ten Questions Screening" tool (TQS) from UNICEF's 'Multiple Indicator Cluster Survey' (MICS) programme, developed for use in resource-poor settings, was used [16]. This TQS tool screens for functional impairments in the domains of speech, motor, hearing, vision, cognition and seizure disorders, by eliciting the caretaker's perception of their child's functioning *vs.* that of other children through simple yes/no questions (Box 1). In addition to the TQS tool, a semistructured questionnaire was newly created to assess the potential extra daily burden to the family. Three questions were used to assess the need for daily assistance, such as the inability to leave the child alone with siblings; the child's inability to feed him/herself; and the caretakers' need to re-organise their daily activities, such as working in the field or going to the market. Both questionnaires were pre-tested, translated into Kirundi and back-translated into French for the interviews. The tool was adapted to cultural/contextual differences of comprehension occurring during pre-testing. As speech is difficult to assess in children prior to 24 months, questions related to speech (questions 8 and 9) were intended only for children who were 24 months or older at the time of follow-up. Acute malnutrition (weight for length <-2 z-score) and chronic malnutrition (length for age <-2 z-score) as well as underweight (weight for age <-2 z-score) were also assessed using standard UNICEF/ WHO definitions and tables [17]. Community health workers, who identified the mothers with their infants, visited the mothers/infants prior to the household interviews in order to make appointments. One dedicated nurse acted as the supervisor and, being experienced in performing household surveys, ensured that the interviews and measurement-taking procedures were respected. This supervisor was also responsible for liaising with community health workers, local district health authorities and relevant institutions and organisations in case impairments or undernutrition were observed.

Data and analysis

All data were double-entered and validated. When inconsistences occurred, they were cross-checked with patient files, questionnaires and if still not resolved, through a dedicated home visit. EpiData (version 3.1) was used for data entry and validation while Version 2.2.2.182 was used for analysis (EpiData Association, Odense, Denmark). Means and Interquartile ranges (IQR) were used for continuous variables, while frequencies and proportions were used for categorical variables. For comparisons,

---

Box 1 UNICEF's Ten Question Screening – tool [16]

A child screening positive to at least one to the ten questions is considered to be at increased risk of disability.

The Ten Questions screen for childhood disability.

1 Compared with other children, did (*name*) have any serious delay in sitting, standing or walking? (Developmental milestones).
2 Compared with other children, does (*name*) have difficulty seeing, either in the daytime or at night? (Vision).
3 Does (*name*) appear to have difficulty hearing? (Hearing).
4 When you tell (*name*) to do something, does he/she seem to understand what you are saying? (Comprehension).
5 Does (*name*) have difficulty in walking or moving his/her arms or does he/she have weakness and/or stiffness in the arms or legs? (Movement).
6 Does (*name*) sometimes have fits, become rigid or lose consciousness? (Seizure).
7 Does (*name*) learn to do things like other children his/her age? (Learning).
8 Does (*name*) speak at all (can he/she make himself/herself understood in words; can he/she say any recognisable words)? (Speech).
9 a. Ages 3–9 years: Is (*name*)'s speech in any way different from normal?
   b. Age 2 years: Can he/she name at least one object (animal, toy, cup, spoon)? (Speech and communication).
10 Compared with other children of his/her age, does (*name*) appear in any way mentally backward, dull or slow? (Intellectual impairment).

---

the chi-square test or where applicable the Fisher exact test (categorical variables) and simple t-test (continuous variables) were used. Significance was set at a P-value < 0.05.

Ethics

Ethics approval was obtained from the Ethics Review Committee, Bujumbura, Burundi, and the MSF Ethics Review Board, Geneva, Switzerland.

Results

Of 2307 babies born in the EmONC facility in 2012, 646 had a LBW of whom 244 needed admission to the NSCU or KCU. Of these, 42 newborns had died during

their stay and six were referred. Another 50 newborns were known to be from outside the target area, leaving a total of 146 LBW neonates who were included in the study (Figure 1).

Characteristics of the neonates at hospital discharge

Of 146 LBW neonates, five (3%) had migrated out of the catchment area, 16 (11%) were not known by the village chiefs or the community (false address?) and patients files of 12 (8%) could not be found. Six (4%) infants had died from infectious or respiratory causes according to their mothers, within a median of 183 days (ranges: 10–191) after discharge. Two were taken to a health facility where they died; four died at home. Reasons for staying at home
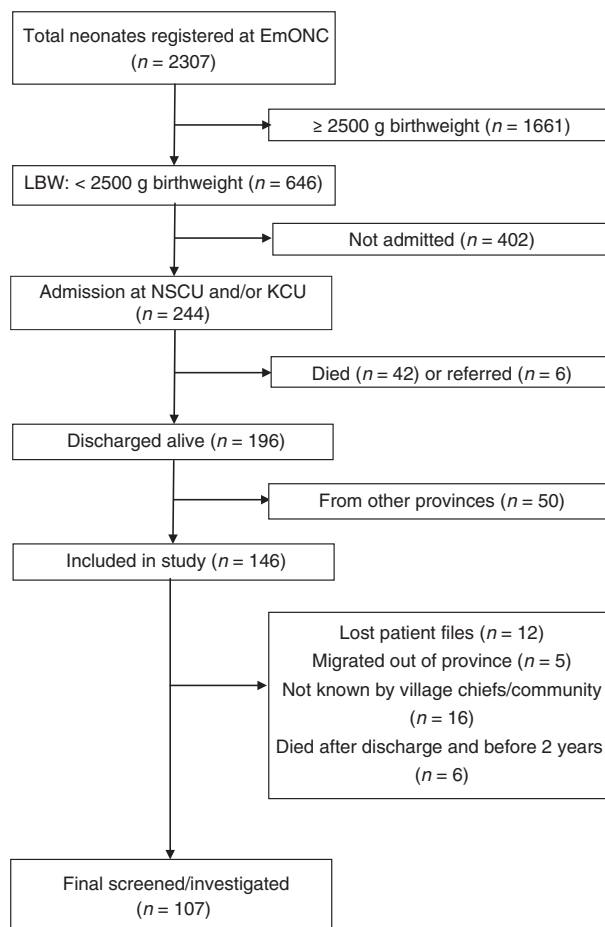

Figure 1 Flow diagram of low-birthweight neonates who had been discharged alive from a specialized neonatal care unit and were followed up for their outcomes 2 years later, Bujumbura Rural province, Burundi (2012). EmONC, Emergency Obstetrics and Neonatal Care; LBW, Low birthweight; NSCU, Neonatal Special Care Unit; KCU, Kangaroo Care Unit.

Table 1 Baseline characteristics of low-birthweight neonates at discharge from a neonatal special care unit, Kabezi district hospital, Burundi (January–December 2012)

Characteristics	N = 107 (%)
Gender	
Male	50 (47)
Female	57 (53)
Twins	
Not	48 (45)
First born	28 (26)
Second born	31 (29)
Weight at birth in grams	
<1500	7 (7)
≥1500–<2000	44 (41)
≥2000–<2500	56 (52)
Resuscitation at birth	
None	75 (70)
Ambu + Mask ventilation (Basic resuscitation)	27 (25)
Advanced resuscitation (ventilation + heart massage)	5 (5)
Hospitalization services	
Neonatal Special Care Unit (NSCU)	28 (26)
Kangaroo Care Unit (KCU)	32 (30)
NSCU + KCU	47 (44)
Median length of stay in days (median, IQR)	10 (4–18)
Final discharge diagnosis	
Premature/dysmature	59 (55)
Risk of Mother to Foetus InfectionΩ	19 (18)
Intrapartum events	12 (11)
Neonatal Infection/Sepsis	11 (10)
Others	6 (6)

IQR, Interquartile range; Ω = Rupture of membranes more than 18 h before delivery, maternal peripartum fever (≥38 °C) before delivery or during labour and/or in case of chorioamniontitis.

were as follows: unexpected death, ignorance about the severity of the situation or health centre too far away. All six had been hospitalised in the NSCU for birth-related pathologies; two were VLBWs.

Characteristics of the remaining 107 (73%) children are shown in Table 1. Median birthweight was 2020 grams (IQR: 1750–2250). Thirty per cent had received resuscitation at birth. One in three was admitted to the KCU only without staying in the NSCU. The median length of stay, in either one or both units, was 10 days (IQR: 4–18). At time of the interview, the median age was 27 months (IQR: 23–29).

Presence and type of sequelae 2 years after hospital discharge

Of the 107 children, 29 (27%) children had one or more impairments; nine (8%) had five or more. The most
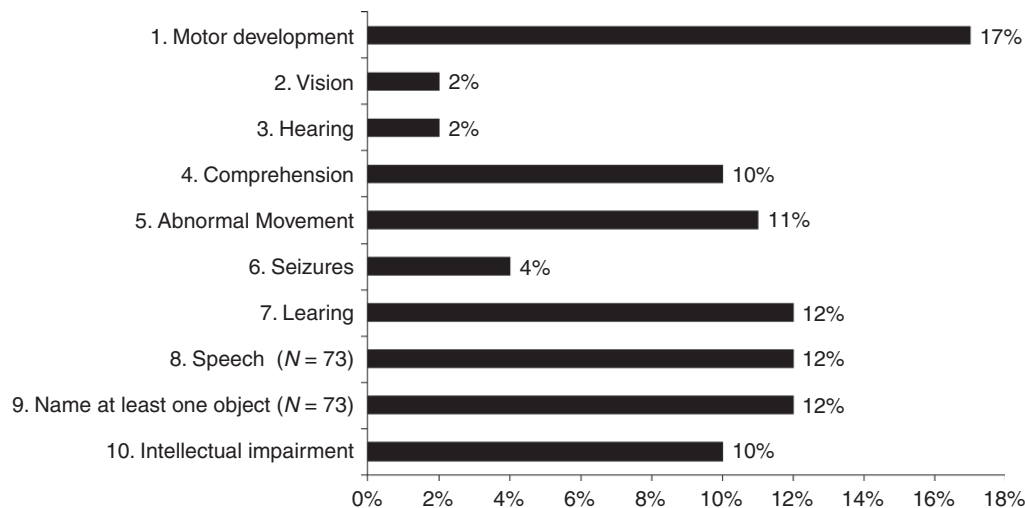
W. van den Boogaard *et al.*   **LBW neonates thrive 2 years later**

Figure 2 Screened impairments among low-birthweight neonates (*n* = 107) 2 years after discharge from a neonatal special care unit, Kabezi district hospital, Burundi (January–December 2012).

frequent impairment was in motor development (17%), followed by learning (12%) (Figure 2) and speech and communication difficulties (12%) in children aged 2 years and older (*n* = 73). Ten per cent of children were reported to have intellectual impairment and difficulties in comprehension. Table 2 shows that some of these sequelae were associated with VLBW. Among those, intellectual impairment was observed to be most prominent (*P* = 0.002). No association was found between the presence of impairments and having undergone basic resuscitation (bag and mask ventilation without cardiac massage) at delivery. 19% (6/32) of children admitted to the KCU had impairments vs. 31% (23/75) of those admitted to the NSCU.

Table 2 Screened impairments and household burden posed by neonates stratified by low- birthweight class 2 years after discharge from a neonatal special care unit, Kabezi district hospital, Burundi (January–December 2012)

Disability/Impairment	Birthweight < 1500 g N = 7 (%)	Birthweight ≥ 1500 g N = 100 (%)	(*P*-value*)
1. Motor development	4 (57)	14 (14)	**0.01**
2. Vision	1 (14)	1 (1)	0.13
3. Hearing	1 (14)	1 (1)	0.13
4. Comprehension	3 (43)	8 (8)	**0.02**
5. Abnormal Movement	2 (29)	8 (8)	0.13
6. Seizures	0 (0)	4 (4)	1
7. Learning	3 (43)	10 (10)	**0.04**
8. Speech†	3 (50)	6 (9)	**0.02**
9. Name at least one object†	3 (50)	7 (10)	**0.02**
10. Intellectual impairment	4 (57)	7 (7)	**0.002**
Burden on household			
Always needs assistance	3 (43)	5 (5)	**0.009**
Cannot eat alone (need to be fed by someone)	1 (14)	4 (4)	0.29
Need to reorganise life/daily activities (e.g.: working in the field, going to the market)	3 (43)	3 (3)	**0.003**

*Fisher exact test *P*-values; †Excluding infants below 24 months of age at interview: *n* = 6 for <1500 g birthweight and *n* = 67 for ≥1500 g birthweight.

(a) Acute malnutrition - wasting (WLZ) **(b)** Chronic malnutrition - stunning (LAZ) **(c)** Underweight (WAZ)
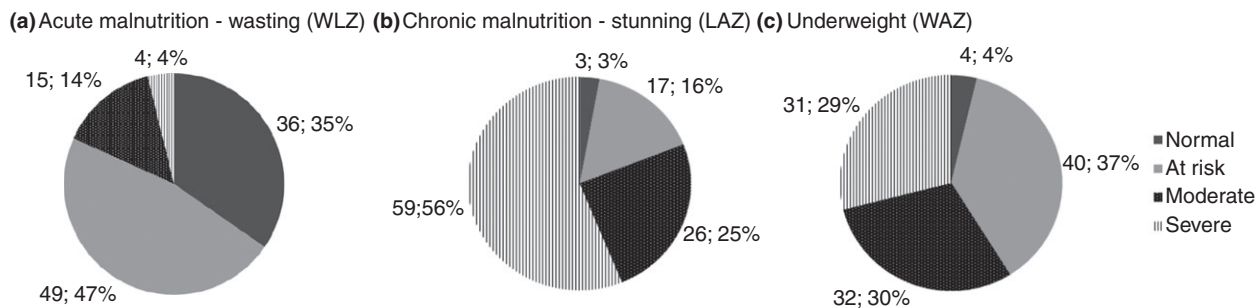

Figure 3 (a–c) Nutritional status of low-birthweight neonates 2 years after discharge from a neonatal special care unit, Kabezi district hospital, Burundi (January–December 2012). WLZ, Weight-for-length Z-score; LAZ, Length-for-Age Z-score; WAZ, Weight-for-Age Z-score.

Daily burden on family due to acquired sequelae

Eight (7%) children (*n* = 107) were reported to be an additional burden to the family. All eight had five or more impairments. They needed constant assistance during the day, and five could not feed themselves. Six families needed to reorganise their routine daily activities due to the disabilities of their children (Table 2).

Nutritional status

More than half of children were underweight, and 80% were chronically malnourished. Moreover, severe acute malnutrition was seen in 4% of children and global acute malnutrition in 18%. Twenty-nine per cent (2/7) of children with a birthweight <1500 g were severely, acutely malnourished compared to three per cent (3/97) of those with a birthweight >1500 g (*P* = 0.014) (Figure 3a–c).

Discussion

This is the first prospective household study assessing the long-term outcomes of children after discharge from a low-technology NSCU in rural Africa. Although the majority was doing well, one in three had at least one developmental impairment and one in ten posed an additional burden on the family. VLBW children had a greater risk of functional limitations compared to the other LBW children. Nearly one in five children were acutely malnourished and eight in ten chronically malnourished. These results highlight the need for closer follow-up and support interventions including therapeutic feeding.

With only six deaths, most LBW infants in this cohort were able to survive for at least 2 years. The 2-year post-discharge mortality rate in our traced cohort was 53 per 1000 children. In rural Malawi, pre-mature babies who survived the neonatal period remained at much higher risk of dying than term babies: 109 per 1000 children vs. 62 per 1000 for children born at term [18]. However,

this study included pre-term babies born at home and not admitted to hospital and therefore most likely represented a different risk group from our study population. Only two of the six infants who died (one death occurred only 10 days after discharge) were taken to a health facility; four stayed at home because their caretaker underestimated the severity of the problem or because the health facility was too far away. These reasons together with cultural practices and/or believing in traditional remedies are well described in the literature [19].

Many children in our cohort appeared to have survived without screened disabilities; 27% screened positive with the TQS tool. In similar (MICS) assessments performed in other sub-Saharan countries, this proportion ranged from 24% in Ghana to 51% in the Central African Republic [16]. We should, however, be cautious when comparing these results, as those studies had a much larger sample size and were conducted on different study populations: children 2–9 years, born with or without vulnerability were included, whereas in our study, all participants started off being vulnerable and were assessed at an earlier median age. The study from rural Malawi showed a 14% positive screen for disability [18].

Compared to other LBW children, VLBW children were at significantly higher risk to screen positive for disability in several domains, including gross motor skills, comprehension, learning and intellect. This is not unexpected, as adverse neurodevelopmental outcomes are known to increase with decreasing gestational age and birthweight [20]. Likewise, the higher risk of impairments in children admitted to the NSCU compared to those admitted only to the KCU can be explained by the fact that children admitted to the NSCU represent a higher risk group, either because of a lower weight at birth or because of associated morbidities, such as intrapartum events or neonatal infection. Neonatal sepsis, for instance, has been found to be an independent predictor for neuro-motor developmental impairment in pre-term infants [21].

In Burundi, a child is never seen as a burden and therefore proxy questions needed to be asked in order to find answers on this 'taboo' question. In already extremely poor families, a child's disability is a very realistic burden and needs to be understood in order to help this family as much as possible by linking-up with existing public or private support programmes. Significantly, our results showed that nearly half of the VLBW children were an additional burden on the household vs. 5% or less for other LBW children. This may be due to the fact that VLBW children were more likely than other LBW children to have five or more impairments, which might be considered a proxy for the severity of the impairment overall. A questionnaire, including scaled response categories or a wider set of questions, could have helped deepen our understanding in this sensitive area better [22].

Finally, the very high rates of malnutrition found in our study were unexpected and concerning. Although Burundi is among the six countries in the world with rates of chronic malnutrition above 50% [23], the burden of chronic malnutrition, 80%, in our study population was staggering. LBW has been associated with a higher risk of chronic malnutrition [10]. In well-nourished environments, there is a potential for catch-up growth in the first 2 years of life but beyond that period very little if any catch-up growth is possible. In some settings, chronic malnutrition has been associated with a higher risk of disabilities [10, 16]. The causal sequence is uncertain, as nutritional deficiencies may be a risk factor for disabilities, or children with disabilities could have reduced potential for growth or reduced access to food [16]. The rate of acute severe malnutrition was alarming and suggests the need for close nutritional surveillance. Only one of the acutely malnourished children was already part of a locally existing nutritional programme. Other acutely malnourished children detected through this study were linked to this nutritional programme at the time of the survey.

The strengths of this study are that we systematically determined the health and developmental outcomes of the discharged neonates in their home environments, which is unique. This also allowed us to assess the daily burden on the family. Interviews were conducted by well-trained and supervised staff in a standardised manner, using the local language. Data were double-entered and validated, including re-visiting homes in case of discrepancies.

Our study has several limitations. We were unable to trace 23% of infants, which is very similar to the study of Ballot [5], but higher than reported in a rural setting from Malawi [18]. However, the study in Malawi was different in that infants were recruited through a double-blind intervention study, which probably facilitated the tracing process. Care was free in the EmONC centre,

which attracted people from outside the province, potentially the reason why 16 people were unknown by the community/village leaders – they might have declared false addresses at the time of hospital registration. These individuals were not included in the analysis, and their true outcomes are unknown. Our declared outcomes are thus subject to this limitation.

Second, the use of the TQS does not confirm a diagnosis of disability; the TQS is a screening tool and relies on further evaluation to confirm diagnosis. Our limited resources did not allow us to go further. It is thus possible that overall and specific disabilities were underestimated, as the questionnaire has previously been shown to perform quite well for identification of severe motor and severe cognitive impairments, but less well for visual and hearing impairments and for detecting mild impairments [24].

Third, the reliance on low-birthweight as a proxy indicator for pre-maturity and/or too small for gestational age is not the most accurate measurement for indicating infant morbidity, mortality and/or longer-term impairments [25]. However, as the lack of reliable data on gestational age is a well-known issue in LMICs [25], use of birthweight categories as a proxy for gestational age is accepted until an alternative is available [26].

Fourth, although we had a dedicated e-database, not all interventions could be captured, such as Kangaroo care being provided in the NSCU before the infant was directly discharged home due to space limitations in the unit.

From an operational perspective, this study highlights the need for a comprehensive post-discharge follow-up strategy for LBW neonates discharged from neonatal units in resource-poor settings. Liaising with primary healthcare services [17], in particular nutrition services, and other multidisciplinary services that provide follow-up care for LBW neonates (and mothers) is urgently needed. Furthermore, in order to reverse or reduce the impact of impairments, innovative community approaches and linkages with relevant institutions providing care for disabled children and support to their caretakers should become part of neonatal care programme planning. In conclusion, this first household survey from rural Burundi highlights the need for continuing follow-up and support for LBW neonates after hospital discharge. *To be alive is more than being saved from death; hence, saving lives implies providing continued support beyond the hospital doors.*

References

1. The World Bank Group. Mortality rate, neonatal (per 1,000 live births), 2014. (Available from: http://data.worldbank.org/indicator/SH.DYN.NMRT) [28 Mar 2016].

2. Howson CP, Kinney MV, McDougall L, Lawn JE *et al.* Born Too Soon: preterm birth matters. *Reprod Health* 2013: **10**(Suppl 1): S1.

3. WHO. Newborns: reducing mortality, 2016. (Available from: http://www.who.int/mediacentre/factsheets/fs333/en/) [16 Dec 2016].

4. Blencowe H, Vos T, Lee AC *et al.* Estimates of neonatal morbidities and disabilities at regional and global levels for 2010: introduction, methods overview, and relevant findings from the Global Burden of Disease study. *Pediatr Res* 2013: **74**(Suppl 1): 4–16.

5. Ballot DE, Potterton J, Chirwa T, Hilburn N, Cooper PA. Developmental outcome of very low birth weight infants in a developing country. *BMC Pediatr* 2012: **12**: 11.

6. Cooper PA, Sandler DL. Outcome of very low birth weight infants at 12 to 18 months of age in Soweto, South Africa. *Pediatrics* 1997: **99**: 537–544.

7. Lawn JE, Davidge R, Paul VK *et al.* Born Too Soon: care for the preterm baby. *Reprod Health* 2013: **10**(Suppl 1): S5.

8. Milner KM, Neal EF, Roberts G, Steer AC, Duke T. Long-term neurodevelopmental outcome in high-risk newborns in resource-limited settings: a systematic review of the literature. *Paediat Int Child Health* 2015: **35**: 227–242.

9. Mwaniki MK, Atieno M, Lawn JE, Newton CR. Long-term neurodevelopmental outcomes after intrauterine and neonatal insults: a systematic review. *Lancet* 2012: **379**: 445–452.

10. Christian P, Lee SE, Donahue Angel M *et al.* Risk of childhood undernutrition related to small-for-gestational age and preterm birth in low- and middle-income countries. *Int J Epidemiol* 2013: **42**: 1340–1355.

11. Tayler-Smith K, Zachariah R, Manzi M *et al.* Achieving the millennium development goal of reducing maternal mortality in rural Africa: an experience from Burundi. *Tropical Med Int Health* 2013: **18**: 166–174.

12. Tayler-Smith K, Zachariah R, Manzi M *et al.* An ambulance referral network improves access to emergency obstetric and neonatal care in a district of rural Burundi with high maternal mortality. *Tropical Med Int Health* 2013: **18**: 993–1001.

13. Zuniga I, Van den Bergh R, Ndelema B *et al.* Characteristics and mortality of neonates in an emergency obstetric and neonatal care facility, rural Burundi. *Public Health Action* 2013: **3**: 276–281.

14. Ndelema B, Van den Bergh R, Manzi M *et al.* Low-tech, high impact: care for premature neonates in a district hospital in Burundi. A way forward to decrease neonatal mortality. *BMC Res Notes* 2016: **9**: 28.

15. UNICEF. UNICEF Data: Monitoring the Situation of Children and Women – The State of the World's Children 2016 Statistical Tables, 2016. (Available from: http://www.data.unicef.org/resources/the-state-of-the-world-s-children-2016-statistical-tables.html) [15 June 2016]

16. Gottlieb CA, Maenner MJ, Cappa C, Durkin MS. Child disability screening, nutrition, and early learning in 18 countries with low and middle incomes: data from the third round of UNICEF's Multiple Indicator Cluster Survey (2005-06). *Lancet* 2009: **374**: 1831–1839.

17. WHO. Global Database on Child Growth and Malnutrition, 2016. (Available from: http://www.who.int/nutgrowthdb/en/) [25 May 2016].

18. Gladstone M, White S, Kafulafula G, Neilson JP, van den Broek N. Post-neonatal mortality, morbidity, and developmental outcome after ultrasound-dated preterm birth in rural Malawi: a community-based cohort study. *PLoS Med* 2011: **8**: e1001121.

19. Manu A, Hill Z, Ten Asbroek AH *et al.* Increasing access to care for sick newborns: evidence from the Ghana Newhints cluster-randomised controlled trial. *BMJ Open* 2016: **6**: e008107.

20. Saigal S, Doyle LW. An overview of mortality and sequelae of preterm birth from infancy to adulthood. *Lancet* 2008: **371**: 261–269.

21. Ferreira RC, Mello RR, Silva KS. Neonatal sepsis as a risk factor for neurodevelopmental changes in preterm infants with very low birth weight. *Jornal de Pediatria* 2014: **90**: 293–299.

22. Trani JF. Screening children for disability. *Lancet* 2009: **374**: 1806–1807.

23. UNICEF. The right ingredients: the need to invest in child nutrition, 2013. (Available from: www.unicef.org.uk/Documents/Publication-pdfs/UNICEFUK_ChildNutritionReport2013w.pdf) [cited 25 June 2016]

24. Fischer VJ, Morris J, Martines J. Developmental screening tools: feasibility of use at primary healthcare level in low- and middle-income settings. *J Health Popul Nutr* 2014: **32**: 314–326.

25. Blencowe H, Lee AC, Cousens S *et al.* Preterm birth-associated neurodevelopmental impairment estimates at regional and global levels for 2010. *Pediatr Res* 2013: **74**(Suppl 1): 17–34.

26. Lawn JE, Gravett MG, Nunes TM, Rubens CE, Stanton C. Global report on preterm birth and stillbirth (1 of 7): definitions, description of the burden and opportunities to improve data. *BMC Pregnancy Childbirth* 2010: **10**(Suppl 1): S1.

Corresponding Author Wilma van den Boogaard, 68, rue de Gasperich, L-1617 Luxembourg City, Luxembourg. Tel.: +352 – 33 25 15; E-mails: vandenboogaardw@gmail.com and wilma.vandenboogaard@luxembourg.msf.org