One year outcome of high-risk newborn infants discharged from the neonatal care unit of the National Maternal and Child Health Center in Cambodia

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Abstract

Background: In the National Maternal and Child Health Center in Cambodia, about 7,500 newborn infants are born every year. Around 10% of them are admitted to the neonatal care unit. After recovery from the acute phase that presented neonatal care unit admissions, they are discharged even if they are very low birth weight infants, but there is no official follow-up system available after discharge. This research aims to identify the prognosis of high-risk infants one year after discharge using regular telephone interviews, identifying the factors that may determine their prognosis.

Methods: When a small and sick newborn infant was admitted to and discharged from the neonatal care unit, we collected health information from medical records. After discharge, we interviewed their caretakers by telephone when the infants were one, six, and 12 months (one year) old. We used

structured questionnaires on feeding, history of illness, and development of growth and gross motor skills.

Findings: Between September 2014 and April 2015, 175 infants were discharged. At one year old, 111 (63%) had survived, 12 (6.9%) had died, and 52 (30%) were lost to follow-up. Nine cases died within one month of discharge. Our data suggested low birth weight may lead to re-hospitalization. Infants vaccinated less than twice at six months old were more likely to be re-hospitalized. According to results of our telephone interview, three infants showed psychomotor retardation at one year old. Among the 50 cases lost to follow-up, 26 (52%) of these patients were discharged without permission by doctors.

Interpretation: After one year, we noted that 63% of discharged infants survived, although 30% were lost to follow-up. There was a limitation of collecting more detailed data by telephone interview than questions about survival. The follow-up for high-risk newborn infants is an important challenge in Cambodia.

Keyword: Pediatrics

1. Introduction

Globally, the mortality of children younger than five years old decreased 52.0% between 1990 and 2015 [1]. However, the reduction in neonatal deaths is smaller: 42.4%. In 2015, 45% of under-five deaths occurred during the neonatal period [2]. The reductions of neonatal and under-five mortalities are now recognized as one of the targets of Goal 3 (Target 3.2) in the Sustainable Development Goals (SDGs) by 2030 [3]. It is well known that small and sick newborn infants have the highest risk of morbidity and mortality among children [2]. Better quality neonatal care is urgently required to reduce preventable newborn death and to reach the SDG targets.

Small and sick newborn infants should ideally receive necessary inpatient services in a neonatal care unit (NCU) at a health facility [4, 5]. There are several reports on the recent situation of newborn care at NCUs in developing countries [6, 7, 8]. Such high-risk newborn infants receive special attention and a long-term care perspective, even after they are discharged from the NCU, as those high-risk infants have higher risks of developmental disability and morbidity than other infants [9, 10, 11]. However, there is little information about the details of the long-term prognosis of infants who are discharged from the NCU in developing countries. Their real progress after they return home is still unknown, especially in poor-resource settings.

In Cambodia, with strong leadership by the government, both maternal and child mortality have been dramatically decreasing in the past two decades [12]. The under-five mortality rate per 1,000 births has remarkably reduced from 117.3 in

1990 to 28.7 in 2015 [13]. Alongside this smoothest reduction of child mortality, there has been a slower decline in neonatal mortality (42.4% from 1990 to 2015) [1]. Thus decreasing neonatal mortality is one of the priorities in the health sector, and the Ministry of Health has set further goals for neonatal mortality: 14 per 1,000 live births by 2020 [14].

The National Maternal and Child Health Center (NMCHC) is one of the top referral hospitals for perinatal care in Cambodia. It is located in Phnom Penh, and pregnant women, especially high-risk cases, are referred there from almost all the southern half of Cambodia. Every year, about 7,500 newborn infants are born in the NMCHC, and around 10% of them need to be admitted to the NCU [15]. Although pregnant women have to pay for delivery, neonatal care service is provided free of charge. Almost all infants who receive admission are low birth weight infants less than 2,000 g, and 20−30% of them die in the NCU within several days. Furthermore, nearly 20% of all patients in the NCU go home without permission/approval by medical doctors, often because of socio-economic limitations.

After intensive treatment during their first several days in the NCU, if newborn infants can suck breast milk or formula a few times, many survivors are discharged immediately, often for social or family reasons, even though they demonstrate very low body weights. After discharge, there is no official follow-up system for such high-risk infants. The NMCHC does not have a pediatric department at present, except for an immunization clinic. Consequently, the high-risk infants discharged from the NCU do not have any opportunity to be followed up by specialists. Some high-risk infants may die or develop chronic health or developmental retardation after returning home, but the real numbers are unknown. In Cambodia, and in many other developing countries, there are few reports on follow-ups on newborn infants who have been discharged from the NCU, but some do exist [16, 17, 18, 19, 20].

This research aims to understand the dynamics for high-risk infant survival within one year following discharge from the NCU of the NMCHC. We will use regular telephone interviews, to identify the factors that determine prognosis after low birth weight/preterm infants return home.

2. Methods

This was a prospective observational cohort study. The study population was newborn infants who were admitted to the neonatal care unit from 1 September 2014 to 31 March 2015. Newborn infants with life-threatening congenital anomalies were excluded.

When a newborn infant was admitted to the NCU, a staff member profiled details of the survey, including its one-year schedule, and received informed consent from family members. Then, necessary perinatal information was collected from the medical charts of both mother and baby, as well as the delivery record. A direct interview of the mother and family members was also held which employed a structured questionnaire. The following information was collected:

1) Basic information: names of parents, patient IDs of mother and baby, address, and several mobile phone numbers of family members;

2) Socio-economic status information: distance from the house to the NMCHC, types of transportation to the NMCHC and their costs, the nearest health facility from the house, designation of family members, income, assets, educational level of parents, occupation, and history of alcohol and smoking;

3) Mother's information: age, gestation, parity, antenatal care, complications of pregnancy/delivery, type of delivery, interventions for delivery, and the reason why she delivered at the NMCHC;

4) Baby's information: presentation, singleton or not, gestational age, birth weight, sex, APGAR score, Silverman's score, and the main reason for admission.

To increase the probability of contacting the family by telephone, we asked for at least three mobile numbers that any family member used.

When the infant was going to be discharged from the NCU, a study researcher visited the NCU again and collected further data about the baby in the NCU, such as final diagnosis, total admission period, and what kinds of treatments the baby had received (incubator or infant warmer, oxygen, continuous positive airway pressure (CPAP), intravenous drip infusion, phototherapy, antibiotics, anticonvulsant, theophylline, etc.). We also checked the details on feeding from both doctors' orders on the medical records and direct interview: types (breast milk, formula, other method) and when these were started.

After discharge from the NCU, when the infant was one month, six months and one year old, the surveyor telephoned the family and asked about the infant's health condition. If the infant had survived, using a structured questionnaire for each age group, the surveyor collected information from the main caregiver, such as the health condition of the infant, types and timing of feeding, history of vaccination, history of visiting health facilities or hospital admissions, with reasons and costs, as well as the current infant weight, if known by the caregiver. Feeding was limited in scope to only one day before the interview ('yesterday'). We also asked several directed questions about motor and mental development such as head up, roll over, etc. based on several standards such as the Denver Developmental Screening Test 2. If the infant had died after our last interview, we used a different questionnaire to obtain the detailed information as to cause of death.

All collected information was put into an Excel database that was developed for this study. All the data were then analyzed with STATA software (STATA release 13). The mother's and infant's name and identification number (ID) were collected to confirm the information at the time of data cleaning and analysis. The correspondence between the unique ID and individual name was kept confidential and managed only by the primary researcher and the co-researcher. After data analysis, all identifying information was deleted to preserve the privacy of the participant.

This study was approved by both the National Ethics Committee for Health Research in Cambodia (Approval ID: 0189 NEHCR) and the Ethical Committee of the National Center for Global Health and Medicine in Japan (Approval ID: NCGM-G-001643-00).

3. Results

Between September 1, 2014, and March 31, 2015, a total of 219 cases were enrolled. Among them, 44 infants died at the NCU before/within discharge. We followed the progress of 175 survivors until they were one year old (Fig. 1) at the time of the telephone interview (one month), 158 infants (90%) were alive, nine (5%) had died and eight (5%) were lost to follow-up. From one to six months old, only three (2%) were identified, but the lost-to-follow-up cases increased: 24 infants (15%). In total, during the first year after birth, 111 (63%) infants among 175 were alive according to our telephone interview, while 52 (30%) were lost to follow-up (Fig. 1).
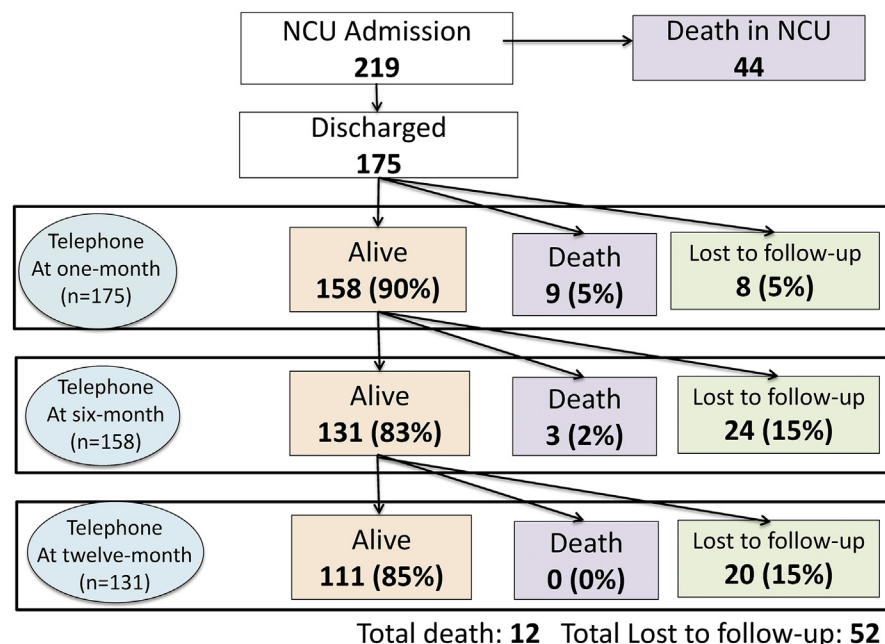

Fig. 1. Outcomes of 175 survivors until they become one-year-old. NCU = Neonatal Care Unit.

Table 1 depicts the general participant information. More than half of the participants resides outside of Phnom Penh. Twenty (11%) families had dual addresses both in Phnom Penh and in another province. One-hundred-twenty-six (72%) infants were born by vaginal delivery, and 47 (27%) by caesarian section. The median birth weight was 1,900 g and the median APGAR score was six. One-hundred-sixty (91%) of infants were singleton, 67 (38%) were discharged without permission by doctors, and six (3.4%) were transferred to other hospitals for more specific treatment or requests from families.

If we identified a mortality case through the telephone interview process, we asked the family about the details of the death in order to gain more comprehensive

Table 1. General information.

	Newborn infants on discharge from NCU (n = 175)
Sex	
Boy	96 (54.9%)
Girl	79 (45.1%)
Address	
In Phnom Penh	65 (37.2%)
Out of Phnom Penh	90 (51.4%)
Both	20 (11.4%)
Income per month (USD)*	260 ± 550 (15−4000)
Age of mother*	26 ± 6 (18−43)
Parity*	1 ± 1 (1−5)
Times of antenatal care*	4 ± 2 (0−9)
Mode of delivery	
Vaginal	126 (72.0%)
Caesarean section	47 (26.9%)
Unknown	2 (1.1%)
Birth weight (g)*	$1{,}900 \pm 670$ (800−4000)
Number of fetus	
Singleton	160 (91.4%)
Twin	12 (6.9%)
Triplet	1 (0.57%)
Unknown	2 (1.13%)
APGAR 5 minutes*	6 ± 2 (1−8)
Hospitalization days*	7 ± 5 (2−25)
Condition of discharge	
With permission	96 (54.9%)
Without permission	67 (38.3%)
Transfer	6 (3.4%)
Unknown	6 (3.4%)

Data are n/N (%) or *median (min−max).

information. All 12 cases of death after NCU discharge were smaller than 2,500 g and died during the first two months post discharge. Nine of the 12 infants died within one month. Moreover, five cases died within two days after discharge. One death was diagnosed as having a congenital malformation. The average days of hospitalization was nine and we could identify three cases that were discharged with medical permission.

After discharge from the NCU, 39 cases among the 111 survivors were re-hospitalized in health facilities within the one-year survey period attributable to some kind of sickness. Table 2 shows the differences in the characteristics between the 'not hospitalized' and 'hospitalized' group. From discharge to one year old, low birth weight (less than 2,500 g) was a significant risk for re-hospitalization (p = 0.021) (Table 2A). Mothers of the re-hospitalized group tended to have a higher education (more than secondary school) than mothers of the not hospitalized group (p = 0.071).

We also explored the relationship between the behavior of caregivers and the history of hospitalization based on the timing of hospitalization for two phases (Table 2B: from one to six months old, Table 2C: from six months to one year of age). When caregivers knew the infants' weights at one-month, infants were more likely to be hospitalized in the period between one to six months (p < 0.001) (Table 2B). Infants vaccinated less than twice by six months of age were more likely to be hospitalized in the period between six to one year of age (p = 0.012) (Table 2C).

Based on our telephone interview, six infants were not able to lift their heads at six months. At one year of age, three out of those six infants could stand up with help, but the other three infants could not roll over. Therefore, we postulated that these cases might have psychomotor retardation based on the Denver Developmental Screening Test [21].

We tried to identify the characteristics of the cases lost to follow-up during the one-year survey period (Table 3). If their father received education until secondary level or higher, or the family income was much more than 200 USD (the estimated total income of an average Cambodian household in 2013 [22]), they were less likely to be lost to follow-up (p = 0.013 and p = 0.001). Infants who had been discharged from the NCU without permission were more likely to become lost to follow-up (p = 0.012).

4. Discussion

This is the first study in Cambodia that investigated the one-year outcome of high-risk newborn infants who were discharged from the NCU. In developed countries, almost all infants who are admitted to health facilities go home when their

Table 2. Differences of characteristics between 'Not hospitalized' and 'Hospitalized' after discharge.

A. After discharged to one-year-old

	Not hospitalized	Hospitalized	P value*
Sex (n = 111)			0.639
Boy (65)	41	24	
Girl (46)	31	15	
Address (n = 111)			0.186
In Phnom Penh or Both (56)	33	23	
Out of Phnom Penh (55)	39	16	
Age of mother (n = 111)			0.276
Less than 35 years old (94)	59	35	
35 years old and older (17)	13	4	
Mother drinks alcohol (n = 110)			0.754
No (83)	55	28	
Yes (27)	17	10	
Mother education (n = 106)			0.071
Less than primary school (44)	33	11	
More than secondary school (62)	36	26	
Income per month (n = 101)			0.523
200 USD or lower than 200 USD (30)	21	9	
More than $200 (71)	45	26	
Parity (n = 111)			0.383
Primipara (65)	40	25	
Multipara (46)	32	14	
Mode of delivery (n = 111)			0.693
Vaginal (80)	51	29	
Cesarean section (31)	21	10	
Birth weight (n = 111)			0.021
$\geqq$2500 g (32)	26	6	
$\leqq$2499 g (79)	46	33	
Apgar score at five minutes (n = 111)			0.185
5−10 (86)	53	33	
0−4 (25)	19	6	
Discharge from NCU (n = 103)			0.921
With permission (69)	46	23	
Without permission (34)	23	11	

Table 2. (*continued*)

B. From one-month-old to six-months-old

	Non hospitalized	Hospitalized	P value*
Exclusive breast feeding at one-month (n = 109)			0.095
Yes (75)	56	19	
No (34)	20	14	
Know baby body weight at one-month (n = 109)			0.000
Yes (49)	24	25	
No (60)	52	8	
Scale body weight at one-month (n = 47)			0.664
At home (24)	11	13	
Others (e.g. at health facility) (23)	12	11	

C. From six-months-old to one-year-old

	Non hospitalized	Hospitalized	P value**
Exclusive breast feeding at both one-month and six-months (n = 109)			0.766
Yes (39)	35	4	
No (70)	60	10	
Know baby body weight at six-months (n = 111)			-
Yes (105)	90	15	
No (6)	6	0	
Scale baby body weight at six-months (n = 105)			0.343
At home (25)	20	5	
Others (e.g. at health facility) (80)	70	10	
Vaccination times by six-months-old (n = 108)			0.012
2 or more than 2 times (96)	86	10	
0-1 times (12)	7	5	
Have paid medical expenses by six-months-old (n = 97)			0.131
Yes (80)	70	10	
No (17)	12	5	

*Chi-square test, **Fisher's exact.

conditions meet criteria for discharge. Furthermore, such high-risk infants are usually followed up regularly by member of the outpatient department, to check growth and development [9]. In particular, very low birth weight infants should be ideally raised in the NCU until the mature enough to return home. For example, the NCU of Kanagawa Children's Medical Center in Japan has strict criteria for discharge, as follows: 1) more than 36 gestational weeks according to the expected date of delivery; 2) more than 1,800 g body weight; 3) stable spontaneous respiratory condition; 4) stable body temperature at room temperature; and 5) stable and

Table 3. Characteristics of the cases of lost to follow-up.

	Follow-up	Lost to follow-up	P value*
Live in Phnom Penh (n = 163)			0.459
Yes (79)	56	23	
No (84)	55	29	
Mother education (n = 155)			0.04
More than secondary level (82)	62	20	
Less than elementary level (73)	44	29	
Father education (n = 158)			0.016
More than secondary level (110)	83	27	
Less than elementary level (48)	27	21	
Income per month (n = 147)			0.001
200 USD or lower than 200 USD (57)	30	27	
More than $200 (90)	71	19	
Antenatal Care more than 4 times (n = 158)			0.241
Yes (102)	73	29	
No (56)	35	21	
Low birth weight (<2500 g) (n = 163)			0.3
Yes (120)	79	41	
No (43)	32	11	
Permission of discharge (n = 153)			0.024
Yes (93)	69	24	
No (60)	34	26	

*Chi-square test.

sufficient oral breastfeeding [23]. However, many health facilities in developing countries do not adopt such strict criteria for discharge as found in developed countries, and they do not have long-term follow-up systems in place to take support discharged infants [16, 17].

In the NCU at the NMCHC in Cambodia, most medical doctors allow patients to be discharged based on demands from their families. Moreover, those high-risk infants have few opportunities to be followed up after discharge, so their progress is often unknown. We predicted that the mortality of those high-risk infants after discharge from the NCU at the NMCHC would be considerably higher because of the inappropriate environment and limited care outside the NCU. However, the actual mortality rate was lower than our expectations. According to our telephone interview, at least 111 among the 175 (63%) infants survived for one year. We suggest two main reasons for this finding. First, caregivers might learn how to take better care of their infants during hospitalization in the NCU. In the NMCHC, family members mainly took care of their infants instead of health staff, because health staff members are

often too busy with other tasks, such as resuscitation or preparing medication. Another reason may be the timing of neonatal deaths in general, most newborn deaths occur during the first 48 hours after birth [24]. During this survey, 44 out of 219 (20%) newborn infants died in the NCU at the NMCHC. All the survivors, therefore, had already overcome the most critical time period: the first 48 hours after birth.

Five deaths out of 12 occurred less than three days after discharge. Additionally, we found that the causes of death after discharge are mostly related to prematurity: apnea, dyspnea, and insufficient feeding. This result strongly suggests that babies were discharged from the NCU too early. There are two reasons for early discharge. First, family members strongly request health staff to permit such discharge often, because they cannot leave work for a long time to take care of their infants in the NCU. Second, the capacity of the NCU is very limited. Every day there are newborns that require admissions there for urgent care; it is therefore difficult to keep infants in the unit for a long time. A feasible follow-up system after discharge is also needed to provide special attention to infants and their families following early discharge [25].

The follow-up system for infants usually includes both a physical and developmental check-up for infants, and counseling for their parents. It is well known that parents with small and sick newborns feel anxiety after the babies are discharged from neonatal intensive care units [26, 27, 28]. Our results also suggest that a low birth weight of less than 2,500 g and fewer vaccinations at six months old might be related to risks of re-hospitalization after discharge from the NCU. When a follow-up system for small and sick high-risk infants is established in Cambodia, it is essential to include not only health examinations for the infants but also careful counseling for their mothers. Following experiences in other countries [16, 17, 20], a next logical step for the follow-up would construct a protocol and conduct a pilot implementation study for high-risk infants after discharge from the NCU at the NMCHC.

In this survey, the tool for follow-up, we used mobile phones. Approximately half of pregnant women came from outside Phnom Penh city; therefore, we thought it might be difficult to request them to return to the outpatient department of the NMCHC. However, even though we asked for three mobile numbers during the registration of this study, about 30% of infants were lost to follow-up. It was difficult to locate all of the families of high-risk infants by telephone once they were discharged. Our results also suggest a relationship between low family income and a high percentage of loss-to-follow-up. Some poor parents did not have their own mobile phones, and borrowed them from others. Additionally, many Cambodians change their mobile number frequently because of promotions by telecommunication companies. Furthermore, in 2015, 1,187,000 Cambodians migrated to other countries [29]. So, some families might have left for economic reasons.

Generally, in Cambodia, infants are not always taken care of by their mother during the daytime, because many mothers return to their work at around two months after delivery. Many main caregivers, such as grandmothers and aunts, often could not answer all the questions about the infants, so we had to call several times to collect enough data from the mothers. Moreover, their families in this survey assessed the developmental indices of infants by themselves, which are ideally collected by health professionals such as pediatricians. Therefore, some infants may not have had their developmental stage assessed accurately.

5. Conclusion

This study presents the one-year outcome of high-risk infants who were discharged from the neonatal care unit in a top referral maternity hospital in Cambodia. One-hundred-eleven among 175 (63%) infants were alive after one year, while 52 (30%) were lost to follow-up. We found that there were limitations to following up of infants using mobile phones. The appropriate follow-up of high-risk infants and long-term care when specific problems are identified will be an important challenge for Cambodia.

Declarations

Author contribution statement

Mari Honda: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Rithy Som, Sody Seang: Performed the experiments.

Rathavy Tung: Conceived and designed the experiments; Analyzed and interpreted the data.

Azusa Iwamoto: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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