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Who can save the unseen?

Studies on neonatal mortality in Quang Ninh province, Vietnam

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Abstract
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Globally, neonatal mortality has remained basically unchanged for the last three to four decades and every year almost four million newborns die before reaching one month of age. This persistent mortality is related to an invisibility of the newborn child in policies and statistics and a neglect of health care decision-makers, planners and practitioners to deliver a perinatal continuum of care. In recent years attention has however been brought to the unchanged neonatal mortality in an effort to improve survival.

The present thesis seeks to increase understanding of obstacles for better neonatal survival. The studies performed are undertaken as sub-studies to the NeoKIP project in Quang Ninh province in northern Vietnam, a randomized controlled trial of knowledge implementation for improved neonatal survival (Neonatal Health – Knowledge Into Practice, ISRCTN 44599712). In the first paper we investigated and discussed the scope of invisibility of neonatal mortality through measuring the accuracy of official statistics on neonatal deaths. The second paper reports an inquiry of determinants of neonatal mortality by use of a population-based case-referent design. Paper III and IV analyse delivery care utilization and care seeking patterns prior to and at delivery using narratives and GIS technique.

There was a substantial under-reporting of neonatal mortality in the official statistics, with study results showing a four times higher neonatal mortality rate in Quang Ninh province than reported to the Ministry of Health. This neonatal mortality rate of 16/1000 live births (as compared to 4.2/1000 in official reports) was unevenly distributed in the province, showing large geographical discrepancies. In the rural and remote areas of Vietnam education level is lower and the concentrations of ethnic minorities and poor households are higher. Ethnic minority belonging was associated with a more than doubled risk of neonatal death compared to the hegemonic group of Kinh (OR 2.08 CI 95 % 1.39 – 3.10). This increased risk was independent of household economic status or maternal education level. Neonatal mortality was also associated with home deliveries, non-attendance to antenatal care and distance to the health care facilities. However, ethnic minority mothers still had an increased risk of experiencing a neonatal death even if they attended antenatal care, delivered at or lived close to a health facility.

The invisibility of the neonatal period in health information systems hides the true width of the neonatal mortality challenge. By not acknowledging the problem, the marginalization of already disadvantaged groups continues, leaving ethnic minority babies with an elevated risk of dying during the first month in life. This example of ethnic inequity highlights the importance to target those most in need. The studies of the present thesis should therefore be looked upon as a contribution to the struggle to illuminate the global burden of neonatal mortality.

Keywords: Neonatal mortality, Inequity, Ethnic minorities, Care seeking, Delivery care utilization, Under-reporting, Vietnam

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To Elisabet

List of Papers

This thesis is based on the following papers, which are referred to in the text by their Roman numerals.

I   Målqvist M, Eriksson L, Nga NT, Fagerland LI, Hoa DP, Wallin L, Ewald U, Persson LÅ. Unreported births and deaths, a severe obstacle for improved neonatal survival in low-income countries; a population based study. *BMC Int Health Hum Right* 2008; 8:4

II   Målqvist M, Nga NT, Eriksson L, Wallin L, Hoa DP, Persson LÅ. Ethnic inequity in neonatal survival; a case-referent study in northern Vietnam. *(Submitted)*

III   Målqvist M, Nga NT, Eriksson L, Wallin L, Ewald U, Persson LÅ. Delivery care utilization and care seeking in the neonatal period; a population-based study in Vietnam. *Annals of Tropical Paediatrics; International Health* 2008; 28(3):191-198

IV   Målqvist M, Sohel N, Do TT, Eriksson L, Persson LÅ. Distance decay in neonatal mortality and delivery care utilisation; a case-referent study using GIS in northern Vietnam. *(Submitted)*

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Contents

Abbreviations

ANC	Antenatal Care
CHC	Community Health Center
CI	Confidence Interval
COR	Crude Odds Ratio
DH	District Hospital
DHB	District Health Bureau
DHS	Demographic and Health Survey
GIS	Geographic Information System
HDR	Home Delivery Rate
IMR	Infant Mortality Rate
MCHN	Maternal and Child Health Network
NeoKIP	Neonatal Health – Knowledge Into Practice
NGO	Non-Governmental Organization
NMR	Neonatal Mortality Rate
OR	Odds Ratio
PH	Provincial Hospital
PHB	Provincial Health Bureau
QN	Quang Ninh Province
Sida	Swedish International Development Agency
SAREC	Swedish Agency for Research Cooperation with Developing Countries
SRB	Sex Ratio at Birth
TBA	Traditional Birth Attendant
U5MR	Under-five Mortality Rate
UBGH	Uong Bi General Hospital (Vietnam – Sweden General Hospital in Uong Bi)
WHO	World Health Organization

Glossary of terms

Case-referent study: A study that starts by identifying people with the event of interest, and subsequently selects reference persons without the event of interest, representing the population which generated the cases.

Child mortality rate: Probability of dying between 1 year and 5 years of age expressed per thousand live births.

Confidence interval (CI): A range that expresses the level of approximation, or imprecision, around the point estimate. Also known as a margin of error. 95% confidence intervals are usually presented: we are thus 95% confident that the true population estimate lies within the range of the confidence interval.

Cross-sectional study: A study that examines the relationship between an adverse outcome, like disease or mortality, and other variables of interest as they exist in a defined population at one particular time.

Early neonatal death: Death of a live born baby within 7 days of birth (day 0-6).

Infant mortality rate: Number of infants below one year of age dying per 1000 live births in a given year.

Knowledge translation: A dynamic and iterative process that includes synthesis, dissemination, exchange, and ethically sound application of knowledge derived from research into practice and policy.

Late neonatal death: Death of a newborn 8 to 28 days after birth (day 7-27).

Low birth weight: Birth weight of less than 2500 g (up to and including 2499 g), irrespective of gestational age.

Miscarriage: Inadvertent loss of a pregnancy before the fetus is viable.

Neonatal period: Pertaining to the newborn period which, by convention, is the first four weeks after birth.

Neonatal mortality rate: Number of deaths during the first 28 completed days of life per 1000 live births in a given year or period.

Parity: The number of full-term children previously borne by a woman, excluding miscarriages and abortions in early pregnancy but including stillbirths.

Perinatal: Pertaining to the period immediately before and after birth. The perinatal period is defined in diverse ways. Depending on the definition, it starts at the 20th to 28th week of gestation and ends 1 to 4 weeks after birth.

Preterm birth: A live birth or stillbirth that takes place after at least 20 but before 37 completed weeks of gestational age.

Skilled birth attendance: Delivery in the presence of a skilled birth attendant, with at least midwifery skills, in an environment that includes availability of equipment, drugs, referral transportation and communication systems.

Stillbirth: The birth of a dead fetus older than 22 completed weeks of gestation or with a birth weight exceeding 500 grams.

Traditional birth attendant: A birth attendant who acquired her skills empirically or through apprenticeship to another traditional birth attendant.

Under-five mortality rate: Number of deaths during the first five years of life per 1000 live births in a given year or period.

Introduction

Neonatal mortality

The first four weeks of life, the neonatal period, is the most vulnerable time for a child. The stress of delivery, as well as the first adaptations from being in the relative safety of its mother's womb to an existence far less protected is a time of great risk. Nearly four million newborns die during this time period each year and world-wide neonatal mortality makes up 40 % of the total child mortality [1, 2]. With an annual number of births in the world reaching 130 million this means that the overall neonatal mortality rate is about 30/1000. This is a level that has gone basically unchanged for the past fifty years, despite minor improvements [3]. In contrast to the tremendous improvements that have been achieved in overall under-5 survival this stagnant development is remarkable. The reasons why the children most at risk are left behind are not easy to comprehend. However in recent years there has been an increasing focus on the neonatal period among researchers and policy makers, calling for action [4, 5], as well as some evidence of an accelerating improvement during the past few years [6]. In order to improve child survival further, measures to reduce neonatal mortality must be taken.

Causes of neonatal death

Official health statistics usually refer to the causes of neonatal death simply as "neonatal causes", without any further explanation, which could be one reason the neonatal period has not been targeted. The causes of death during the neonatal period are different compared to the causes of death later in childhood, and are to a large extent connected to the hazardous transition at delivery and the adaptation to life ex-utero. But these causes are nonetheless well defined and specific measures can be taken to avert them. In a global perspective the direct causes of neonatal deaths are infections, including tetanus and diarrhea (36 %), preterm birth (28 %), and asphyxia (or intrapartum-related causes) (23 %) (*Figure 1*) [1, 7, 8]. The contributing causes are numerous and have strong relationships with social structures, such as access to health care, education, and traditional beliefs. For example, half of all deaths during the first four weeks occur at home, and in sub-Saharan Africa 60 % of all deliveries happen without professional or trained assistance. In South Asia, the figure is even higher, with 70 % of deliveries

taking place at home without a midwife or similar [9]. Apart from lack of medical resources and geographical inaccessibility, there is also a reluctance to seek care when care quality is often low [10]. Strengthening and developing health services must therefore go hand in hand with education and the adequate dissemination of information to prospective parents. Another important factor affecting neonatal mortality is low birth weight (< 2500 grams), which is an underlying cause in 40-80 % of neonatal deaths. This is especially important in South Asia where the proportion of children with low birth weight in certain places is one-third [11].
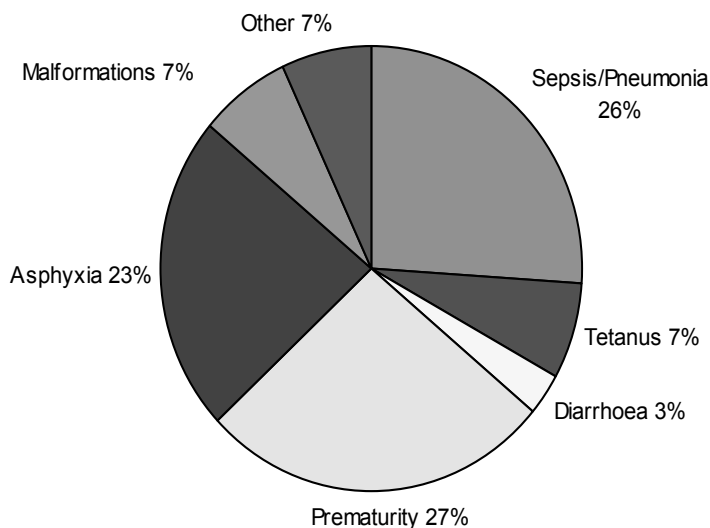

Figure 1. Causes of neonatal death [7]

Inequity in survival

Another reason for the stagnant development in neonatal survival might be found in global inequity. While Sweden and the rest of the industrialized sector maintain a neonatal mortality rate of 2-3/1000, it is not uncommon that this rate reaches over 60/1000 in the poorer segments of the world [6]. Ninety-nine percent (99 %) of all children who die during the first week of life are doing so in the poorer parts of the world, especially in sub-Saharan Africa and South Asia [7]. In fact, most children die in India, accounting for nearly a third of total global neonatal mortality. This is partly due to India's large population, but foremost a result of a lack of resources and poor dissemination of knowledge. If you were to compare this with China, which has a population in parity with India, half as many children die during the neonatal period, indicating that societal and structural factors in China play an essential role in neonatal survival. This is further emphasized by

calculations indicating that the cost of improving neonatal survival is modest, and that measurable mortality reductions could be achieved through implementation and scaling up of effective interventions [12]. It is a common misunderstanding that the interventions to save newborn are expensive including a need for high-tech solutions. However, history tells us that many countries in the Western world achieved a reduction in neonatal mortality rate down to 15/1000 long before the advent of today's specialized care [13, 14]. Moreover, one can now see examples of countries, such as Vietnam, Nicaragua and Moldova, which show that a country's GDP is not always correlated with the neonatal mortality [4].

That almost 4 million newborn children die every year constitutes an enormous mental and social trauma for the families affected. Morally, it is of course totally unacceptable when adequate interventions are known and applicable, however, neonatal death also represents a great problem socio-economically. In one respect, it is considered as a waste of resources; on the other hand, the uncertainty within the area of reproductive health to address neonatal death as a serious issue creates a reluctance to invest emotionally and economically in the newborn. Winch and co-workers who have studied the problem from a social-anthropological perspective in Bangladesh point to the fact that there is a great deal of fatalism involved when it comes to the health and survival of the newborn, both among health care workers as well as among families [15]. The belief that we cannot influence what happens becomes a destructive coping strategy, for the individual as well as for societal development.

Recent development

What is being done to improve the situation of the world's newborn children? While the overall development should be identified as slow, with only 34 % of countries on track to meet MDG 4, there have in the past five years been signs of an accelerating progress toward reducing the neonatal mortality rate [6]. Success, however, is unevenly distributed across the globe, with the largest decline in Latin America since 1990. Worst affected are some of the African countries, which have seen an increase (!) of neonatal mortality over the same period [6]. A strong contributing factor to this is the HIV/AIDS situation in sub-Saharan Africa, and the implications it might have on already inadequate health systems. Notwithstanding, some positive examples are showing what is possible. For example, some Latin American countries managed to reduce the number of deaths during the first month of life by over 50 %. In India, on the other hand – which accounts for the largest proportion of neonatal deaths – in absolute numbers there has been a decrease of only 11 %. This reduction is largely explained by the decline of tetanus cases. Globally since 1990, tetanus, as a cause of neonatal mortality, has been reduced most significantly by 50 % [7]. This has mainly

taken place through tetanus vaccinations of pregnant women. However, the challenge of reducing neonatal mortality cannot be solved through ad hoc projects. To increase the survival of the newborns and assure an even distribution of improvements, long-term strategies are needed that integrate into existing maternal and child health care programs.

Possible interventions

What can be done to reduce the neonatal mortality rate? Studies show that 41-72 % of neonatal deaths could be prevented if the actions we now know to be effective would be implemented on a large scale [12, 16]. Initiatives in the field are taken and implemented by governments and/or NGOs: among others, Save The Children U.S., with contributions from the Bill and Melinda Gates Foundation, has developed an action plan to improve neonatal health [17]. Marsh et al have identified five key priority areas for this work [18]:

1. use of routine maternal and newborn care and good-quality services
2. response to maternal danger signs
3. response to the non-breathing newborn
4. care for the low birth weight baby
5. response to newborn danger signs, particularly those of infection

These interventions can be implemented with simple and cost-effective means. For example, in an acclaimed article in the *Lancet* in 2004, Manandhar and colleagues reported on a study conducted in Nepal, which, by simple means, succeeded in reducing the risk of neonatal death by 30 % (OR 0.70) over a two year period [19]. The intervention was based on participation in which women gathered in groups and themselves identified perinatal health problems that existed in their own environment. By setting up local networks and highlighting issues around childbirth and care of the newborn, a context was created in which information and knowledge could be disseminated in an effective manner, which in turn resulted in positive changes in behavior. The large decline in neonatal mortality that, in this way, was accomplished within a short time indicates that it is possible to make great efforts to improve neonatal health with relatively simple means and where community based interventions have been encouraged [20]. Recently, two studies, one from India and one from Bangladesh, have applied the same method of knowledge implementation to improve neonatal health and found diverging results [21, 22]. While the intervention was successful in the Indian states of Jhakarand and Orissa [22], it failed to show significant improvement of neonatal mortality rate (NMR) in Bangladesh [21].

Contextual factors have been put forward as an explanation of the different outcome, something that remains to be explored.

More research is needed

If the required means should be implemented, there needs to be a solid evidence base on what works and what is cost-effective. Bhutta and colleagues, in a review of studies [10] made in the field of neonatal mortality, found that the amount of research is proportionately scarce considering that it is an area with so much influence over people's daily lives. Only 10 intervention studies in specific health systems were available for review, and there was a remarkable lack of large-scale trials evaluating the effectiveness of various interventions. Interventions to improve neonatal health are, to a great extent, about changing habits and behaviors. In order to change there is a need to identify barriers and obstacles for survival. At the same time, there is consensus on which health interventions work, thereby creating the important question of how best to implement such existing knowledge [12]. Indeed, how do we translate the existing knowledge about how neonatal survival will be improved into a sustainable working practice? [23] One way, which Manandhar and colleagues demonstrated in their study in Nepal [19], is to involve more parts of society, thereby strengthening the sense of ownership and the ability to create change. Nevertheless, the studies from India and Bangladesh demonstrate the importance of context for the effect of the intervention. What works in one setting does not necessarily work in another, and there is a need to pay attention to the design of the intervention as well as to contextual factors related to the health system and the society where the intervention takes place [21].

Neonatal health – Knowledge Into Practice (NeoKIP)

Inspired by the Nepalese study by Manandhar and colleagues, research collaboration between Uppsala University, Uong Bi General Hospital and the Ministry of Health (MoH) in Vietnam was initiated in 2005. The resulting study, referred to as NeoKIP, [an acronym for "Neonatal Health – Knowledge Into Practice" (ISRCTN44599712)], was planned to investigate a method of knowledge translation through a population-based cluster-randomized design. This method, known as 'facilitation', can best be described as a group-based enabling approach utilized to support change. Facilitation has been shown to be a potentially favorable intervention for enhancing knowledge uptake [24]. The choice to investigate facilitation as a method of knowledge translation was based on research that suggests innovations and new knowledge are spread and utilized as an effect of interaction between individuals and social influence rather than on the availability of written information [25]. With the notion of social interaction

and group processes as the driving force for change, the NeoKIP project intended to investigate whether or not access to evidence-based knowledge (through the National Guidelines issued by the MoH), and the interaction between practitioners and key community members (through a problem-based planned work method that was generated through facilitation support) would lead to a process of change and effectively achieve improvements in neonatal health. There was also a need to find ways to be able to scale-up this process, which had been proven successful in the Nepalese setting through a fairly large amount of women's groups. The NeoKIP study therefore chose to plan the intervention within the existing health system by forming Maternal and Newborn Health Groups (MNHG) at Community Health Centers (CHCs).

The research presented in this thesis was undertaken within the scope and organization of the NeoKIP project, with the intention to investigate obstacles and determinants of neonatal survival. The NeoKIP study is proposed to continue through July 2011, before the impact of facilitation on neonatal health can be fully analyzed.

The Vietnamese setting

Child health and inequity in Vietnam

Vietnam is a country that for many years has shown relative good health statistics in relation to its overall economic status. Through sustained investments in primary health care, Vietnam has achieved great reductions in infant and child mortality rates [26]. Officially, the NMR in Vietnam is 12/1000 (2004) [27]. However, a study in Bavi district, a health surveillance site west of Hanoi, showed a persistent neonatal mortality rate over the last three decades of the last century (*Figure 2*) [28], exhibiting the same trend as has been shown in many other countries around the world. This study has influenced the choice of study topic for the NeoKIP project as well as for this thesis, and was a call for action in the Vietnamese setting. Recognizing this trend of persistent neonatal mortality, the Ministry of Health in Vietnam has made neonatal mortality and perinatal health a priority: evidence-based guidelines on reproductive health were launched in 2003 [29]. The Bavi study not only showed a stagnant neonatal mortality, but also indicated that ethnicity was a major risk factor for neonatal death, whereas education and economic status was not. Ethnic minorities in Vietnam are living in more remote mountainous areas compared to the hegemonic ethnic group (Kinh), and there was a sharp social inequity arising from minority status [30]. Minority groups are poorer and less educated compared to the Kinh group, and evidence shows that the minority groups benefitted by the ongoing
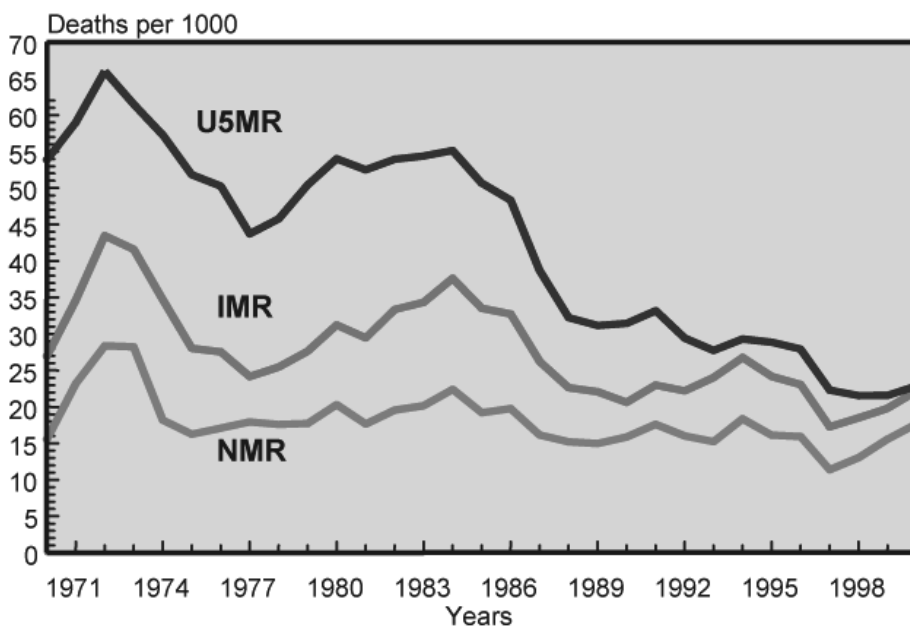
Figure 2. Neonatal mortality rate (NMR), infant mortality rate (IMR) and under-5 mortality rate (U5MR) over time (moving 3-year averages) in Bavi district in northern Vietnam [28].

development in Vietnam to a smaller extent compared to the majority group [31]. The inequity does not, however, only go with resources, but is also due to a combination of social factors most likely involving both external barriers – such as language and discrimination – as well as such internal factors as traditions and seclusion. The inequity is also notable in health, with a higher IMR and shorter life expectancy among ethnic minorities [31]. There is evidence of ethnic differentials in health care-seeking behavior, which could be factors causing the discrepancy in health statistics between ethnic groups [32]. The overall institutional delivery rate is high in Vietnam, reportedly 64 to 79 % during the last couple of years according to different sources [33, 34]. Ethnic minorities are, however, more likely to deliver at home [35], resulting in an increased risk of both stillbirths and neonatal death for these groups.

Son preference and SRB

Vietnam is a country influenced by Confucianism, especially in the northern parts of the country where Chinese culture is more predominant. According to the teachings and traditions of Confucius, it is the son of the family who will get the inheritance and preserve the family line into the future. It is also

19

the son who is allowed to sacrifice for the ancestors and looks after their graves [36]. Thereby, a son has the responsibility to look after the well-being of deceased relatives, and failing to have a son is considered disrespectful to the ancestors. This strong preference for sons, for cultural, economic and social reasons, has been one of the driving forces of an increasing sex ratio at birth (SRB) in recent years [37].

A two-child policy was formally introduced by the authorities in Vietnam in 1988 in order to lower fertility rates [38]. This policy was successful in the sense that the fertility rate decreased from 3.8 to 2.3 during the period 1989-1999 [39]. In the beginning of the new millennium the policy shifted to a "small-family size" norm. After a couple of years, the fertility rates started to increase and a reinforcement of the one-to-two-child policy was issued in 2005. The efforts by the authorities to keep fertility rates low, together with an increasing spread of ultrasound technique in a society with strong son preference, has lead to an increasing SRB. Since 2004, the SRB has increased by 1 every year, reaching 112 in 2008 [40]. Ultrasound and abortion are free in Vietnam, but sex determination and selective abortions are illegal according to a decree issued by the Vietnamese authorities [41]. This document does not, however, state how the regulation should be enforced, and there is a widespread overuse of the ultrasound technique with reports of 6.6 ultrasound scans on average among pregnant women in Hanoi [42].

Son preference and an increasing SRB have implications for the neonatal period, as well. Studies have shown excess female child mortality in cultures with son preference, such as China and South Korea [43, 44]. This increased risk of child mortality for girls is usually explained in terms of discrimination against girls, socioeconomically, as well as through health-related behavioral factors [44]. Care-seeking patterns are different for girls, and home deliveries are more common if the mother is expecting a girl. A study from China showed that two-thirds of the excess female deaths took place within the first 24 hours after delivery, displaying the importance of delivery place as well as the possible neglect of female newborns [44]. Stories of neglect and even infanticide are not uncommon in this region even if it is a difficult thing to verify statistically.

Concepts of the neonatal period

Beliefs and how we look upon the world greatly influence our behavior, and the neonatal period is no exception. In the Vietnamese setting Confucianism, Buddhism and Taoism coexist in what is called the "triple religions" (*tầm giao*). Confucianism handles morality and social interaction, as exemplified above with a strong preference for sons in the society. Taoism deals with the interpersonal relationships as well as the changes and fluxes of nature. Buddhism, in turn, renders an explanatory model for life and the afterlife,

and Buddhist rituals at birth and death are important parts of Vietnamese life [45]. When a child is born there is an expected "isolation time" for the newborn and mother, lasting 7 days for boys and 9 days for girls [46]. No visitors are allowed into the family's home during this period, which is in contrast to official guidelines for newborn health care stating that home visits by a midwife should take place during the first week after delivery. Even if most midwifes report home visits according to the guidelines, these are very seldom performed since home visits are in opposition to traditions and customs that advocates such a period of isolation for the mother and newborn after delivery. After this period, which often is extended to one full month, a "Thanksgiving for the Midwives" is observed (*Lễ Cúng Mụ*) with sacrifices to the 12 divine midwives [46]. The next ritual of importance is the "Rite of the First Full Month" (*Lễ Đầy Tháng*), where the newborn is named and officially celebrated together with friends and relatives [46]. After this ritual, which coincides with the end of the neonatal period, the isolation is completely over.

After one year, the "Rite of One Full Year of Age" (*Lễ Đầy Tuổi Tôi*) is held. This celebration is an expression of gratitude towards the ancestors and it marks the humanhood of the child. Not until this time is the child regarded officially as a "human being" (*con người*). Thus, if a child dies before reaching one year of age it will not be considered to possess a soul and instead of becoming a ghost (*ma*), it would become a "little demon" (*ranh*). This "little demon" is believed to be able to reincarnate, which would mean a lot of misfortune and problems to the family unless handled in a correct ritualistic way [46]. This concept of a newborn not being fully human may affect the way newborns are treated and perceived, and has implications for the health care system: in practice, but also for the reporting system and for the practical implementations of neonatal care policies [47].

Determinants of neonatal mortality

All good research rests upon a theoretical foundation, and the conceptual framework for this thesis is adopted from Mosley and Chen, who were inspired by Davis and Blake [48] and in 1984 suggested an analytical framework for child health studies [49], which has since been widely used. Mosley and Chen tried to combine sociological and biological explanatory models into a single conceptual framework by sorting independent variables as either socioeconomic (distal) determinants or proximate determinants, creating a hierarchy for analysis. Victora and colleagues further stress this hierarchical approach when they claim that a common mistake in epidemiological literature is to analyze distal and proximate factors as being at the same level, which results in a reduction or elimination of the former's effects [50]. The model set up by Mosley and Chen has later been adapted to

fit specific areas, for example HIV/AIDS [51], neonatal health [52] and maternal mortality [53], and the framework set up in this thesis is a further adaptation for the analysis of neonatal mortality risk factors (*Figure 3*).

Socioeconomic determinants

The socioeconomic determinants in the model presented here are ethnicity/culture, religion/conceptions, education/skills and economy/wealth. The arrows in the model suggest that all the socioeconomic determinants are interrelated and affecting each other. For example, is the level of education affecting the amount of income, generating wealth or sustaining poverty, while at the same time a high economic status increases the possibilities for a better education. Even in Vietnam, being a communist country, this is valid, especially with the transformation from planned to market economy and rapid economic development of recent years. The influence of maternal educational level on child health has been explored in many studies. In a seminal paper from studies on maternal mortality in Nigeria in 1979, Caldwell discusses the reason that well educated mothers have better health indicators as being due to their ability to better understand and use the health system, compared to their less educated peers [54]. It would also be reasonable to assume that mothers with higher education are more prone to internalize and adopt new knowledge and behavior, for the benefit of themselves and their offspring. The impact of household economy on neonatal survival could be both direct – through payment capacity directly related to delivery or sickness – and indirect, by the manifestation of better nutritional status. In Vietnam, there are now user fees in the health care system, both official as well as unofficial [55]. However, if a family is poor, it can obtain a certificate from the authorities stating their low economic capacity and thereby assuring them health care free of charge (at least when it comes to official fees). Religion and conceptions about life influence cultural pre-understanding as well as how to relate to wealth and education. Religious beliefs and customs also affect neonatal health and the chances for survival, such as the Vietnamese tradition of not considering a newborn child fully human until it has reached one year of age [47], as described above. Also described above is another factor that could greatly influence the care and survival of newborns: the preference for sons, which is closely related to patrilinearity and patriarchic structures [56], and in the end affects the decision-making power of women. As mentioned above, Vietnam for many years has had a two-child policy, and the desire to breed sons together with an increased spread of ultrasound has, in recent years, led to a sex ratio at birth well above normal variations [37].

Socioeconomic Determinants

Ethnicity/Culture ⟷ Religion/Conceptions

Education/Skills ⟷ Economy/Wealth

Proximate Determinants

Maternal factors
- Emancipation
- Nutrition
- Occupation
- Age
- Civic status
- Birth spacing
- Household structure

Health system factors
- Access
- Distance
- Attitudes
- Awareness
- Resources
- Competence

Neonatal factors
- Sex
- Gest. age at birth
- Birth weight
- Birth order

Delivery factors
- Place
- Mode
- Assistance
- Complications

Postnatal care
- Surveillance
- Nutrition
- Hygiene
- Care seeking

Interventions

Temperature control | Resuscitation | Exclusive breast feeding | Infection management
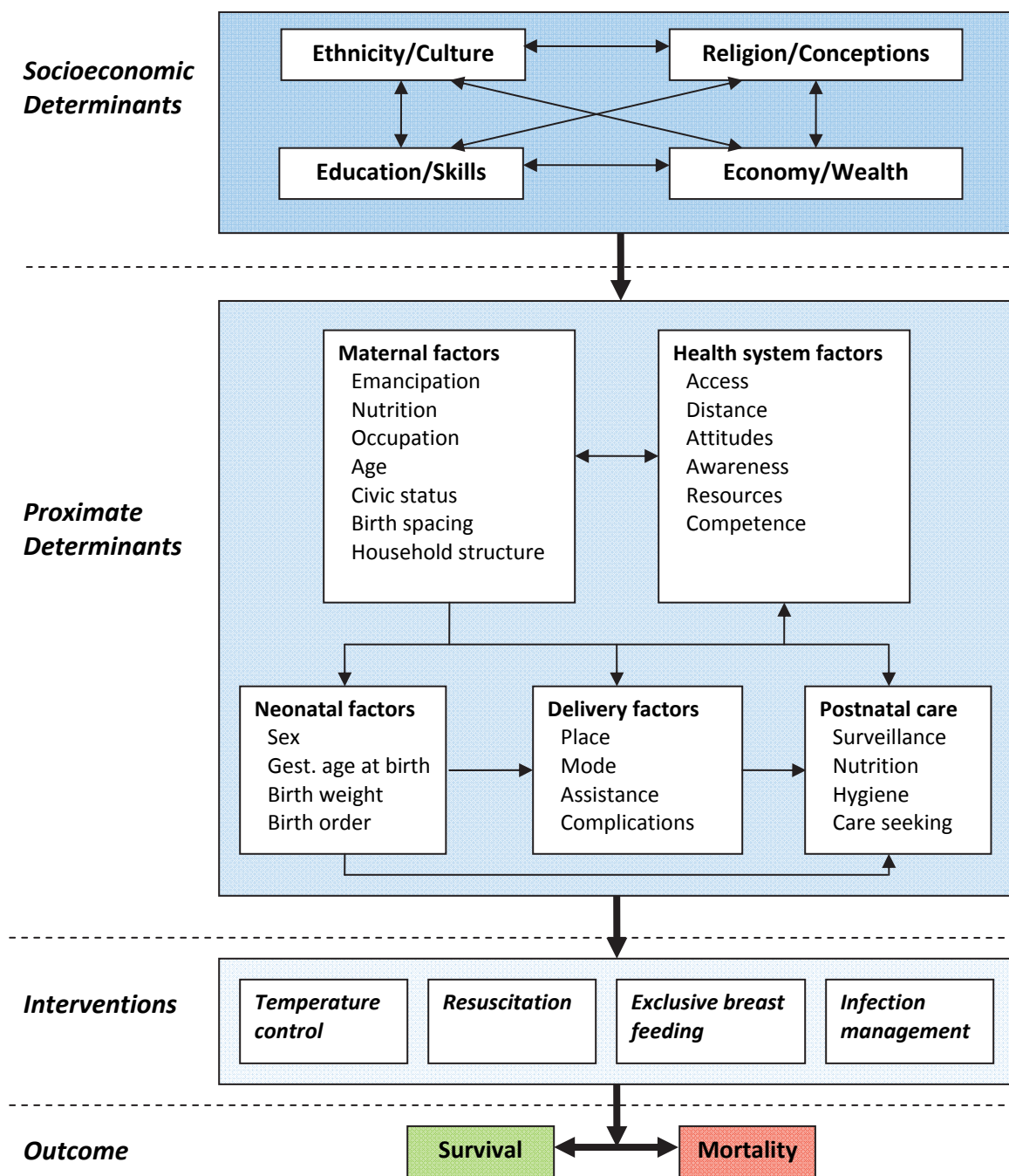
Outcome

Survival ⟷ Mortality

Figure 3. Conceptual framework for factors influencing neonatal mortality, adapted from Mosley and Chen [49].

Proximate determinants

The proximate determinants in this model are divided into five categories; maternal factors, health system factors, neonatal factors, delivery factors and postnatal care. In most models, there is no hierarchy among the proximate determinants, and it is not strictly in this model either. However, by putting maternal and health system factors above the other groups acknowledges the circumstance that these two have a significant impact not only on the outcome, but also on the three other groups. Characteristics of the mother are of great importance when it comes to birth weight and even the sex of the newborn. The level of female emancipation may decide where the delivery takes place and who is assisting [57, 58]. Further, characteristics of the health system, for example attitudes and availability, greatly influence delivery place [59] and the postnatal care [60, 61]. Notable is that not all arrows between proximate determinants are two-way. The characteristics of postnatal care do not, for example, influence the neonatal factors, whereas the sex of the baby may have a considerable impact on the postnatal care. Maternal factors are not easily affected by the other groups, but of course have a major influence on the choice of delivery place and the quality of postnatal care.

Interventions

In the end, the difference between death and survival in the neonatal period is dependent upon what responses are given to the newborn's needs and to the threats to the neonate's health. Most of the interventions needed to save newborn lives are not complicated, costly or high-tech, but instead simple and straightforward with a potential of reducing mortality with up to two-thirds [16]. With the addition of resources and the latest medical technology, it is possible to save almost all newborns, as statistics from Singapore exhibit, further emphasizing the importance of actions taken or not taken [62]. By adding the level of interventions in the model, we would like to express that there is nothing definite or unavoidable with neonatal deaths. The interventions in the model are examples based on priorities made by WHO.

Delivery care utilization

In order for interventions that improve the chances for neonatal survival to be put into practice, demand and supply need to meet: there should be enough resources and knowledge among care providers, as well as adequate care-seeking behaviors and a readiness and willingness to utilize the existing

health system among families. Therefore, one proximate determinant that has been investigated in this thesis is how mothers utilize delivery care.

Skilled attendance at birth

One of the most important factors to ensure neonatal survival (as well as a reduction in maternal mortality) is the presence of skilled attendance at birth [63, 64]. To be skilled, however, is not the same as being trained, and in a joint statement from WHO, UNFPA, UNICEF and the World Bank, the definition of skilled attendance is

> ''exclusively referring to people with midwifery skills (for example midwives, doctors and nurses) who have been trained to proficiency in the skills necessary to manage normal deliveries and diagnose, manage or refer obstetric complications. They must be able to manage normal labour and delivery, recognise the onset of complications, perform interventions, start treatment and supervise the referral of mother and baby for interventions beyond their competence or not possible in the particular setting'' [64].

To have skilled attendance at birth might avert a large proportion of all intrapartum-related neonatal deaths if good coverage is reached [16, 65]. A person with knowledge about and experience of difficult situations and potential delivery complications is taken for granted (and is almost expected as the 'norm') in most high-income countries. Yet, in many places of the world this is not the norm, and globally 65.7 % of all pregnant women deliver without a skilled attendant (2008 estimate). In Asia, the skilled attendance rate is as low as 46.5 % [66]. According to global calculations by WHO, there are about 330 000 midwives missing to fill the need [67]. For this gap to be filled there needs to be a serious commitment made by government and health care planners. In attempts to speed up the process of safer deliveries, numerous trials to train Traditional Birth Attendants (TBA) have been performed, with the notion that TBAs would be more available and accessible within a community. Evidence for the effectiveness of TBAs in reducing maternal and neonatal mortality is, however, still controversial and much of their ineffectiveness depends on their lack of integration with existing health systems as well as the absence of emergency back-up systems [68]. The efforts with community-based strategies must therefore be combined with health system strengthening strategies in order to have a chance to succeed [63, 68].

The place of birth

In fact, the definition of skilled attendance at birth involves two components – both the presence of skilled health personnel as well as an "enabling environment", which means adequate supplies and equipment, possibilities

for transport and effective communications [66]. The recognition of needing to strengthen these parts could also be expressed as understanding the importance of where a delivery takes place [69]. Any complications that might arise during delivery, for mother or child, need immediate attention; and the time to intervene is short [65]. Being at the right place at the time of delivery therefore considerably increases the chances of neonatal and maternal survival [70, 71]. Results from the NeoKIP baseline in Vietnam showed, for example, a strong link between home delivery rate (HDR) and NMR at district level (*Figure 4*) [72].

Neonates born at home are often delivered without skilled attendance and are at a higher risk of intrapartum-related death and morbidity [68]. Even if deliveries with skilled attendants could be performed either at home or at a health facility, it has been argued that the most effective strategy for low-income settings would be to have deliveries with skilled attendance at a health center with at least a good referral capacity in case of emergency [73]. In reality, skilled attendance in most places therefore becomes synonymous with facility delivery. Even if a delivery takes place at a health facility,
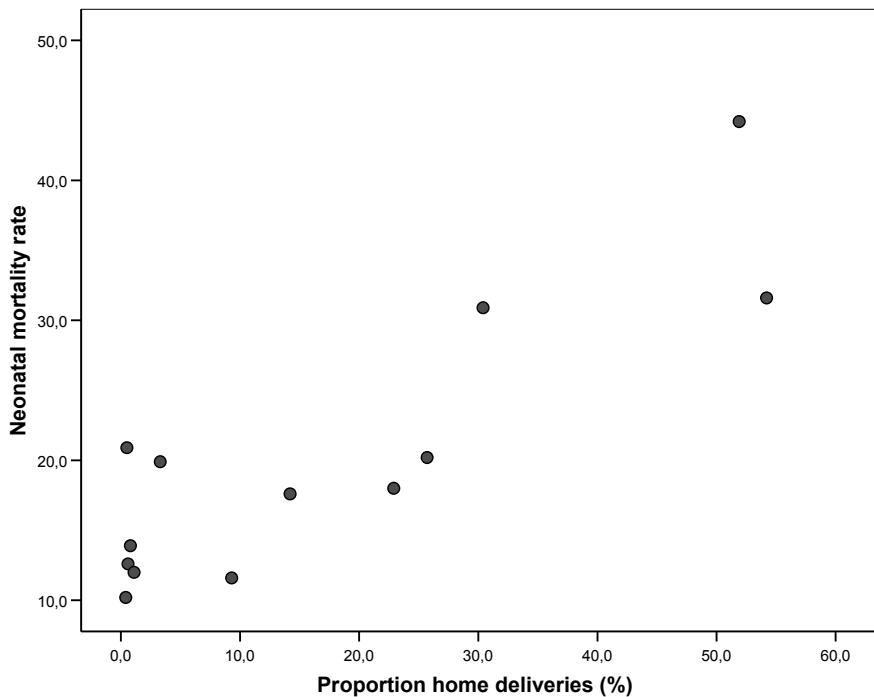

Figure 4. Percentage of home deliveries in relation to NMR in 2005 in the 13 districts (two smaller adjacent districts combined) of Quang Ninh province, Vietnam [72].

however, the quality of care received is decisive. Many factors play a part, as illustrated by "health system factors" in the framework above. Equipment and facility status, attitudes, and knowledge among staff etc, are just some factors which matter. These factors could, on the other hand, be difficult to measure on an aggregated level, and instead the place of delivery can act as a proxy for the overall delivery situation. In the Vietnamese setting it is reasonable to assume that higher levels in a health care system will mean better conditions, and that resources are concentrated at certain locations. This should be considered together with such negative factors as overuse, which results in crowding, and that mothers might perhaps have to travel long distances in order to get to higher level facilities.

Care-seeking at delivery

The importance of continuum of care, from detection of pregnancy through childhood, has received in recent years an increasing amount of attention among researchers and health care planners [63]. The purpose of highlighting the continuum of care, defined as continuity and coordination in the care of mother and child, is to promote a holistic approach to pregnancy and child birth, since the health and well-being of mother and child are inter-related. In this thesis, however, the focus will be on specific parts of the continuum, i.e. delivery care facilitation and care-seeking at delivery, Nevertheless, it is important to bear in mind the broader picture.

The three delays of seeking care

One important aspect of safe motherhood and delivery is care-seeking. Moreover, the decision to seek appropriate care at the time of delivery, as well as the road to ensuring a safe delivery, is an important determinant of neonatal outcome. In a widely cited review article from 1994, Thaddeus and Maine present a conceptual framework of three delays in care-seeking [74]. They were mainly focusing on obstetric emergencies within a setting having a high home delivery rate, but their framework is applicable to most care-seeking situations.

The first delay potentially occurs during the time it takes from onset of a condition requiring medical attention until the decision to seek care is taken. This time, often referred to as "Patient's delay" starts with the recognition of disease, but also involves socio-cultural factors influencing the decision. To lessen the first delay, and sometimes even to get to the decision to seek care, is a priority for improving maternal and newborn survival [75, 76]. To spread knowledge and educate families and health workers about the recognition of danger signs during the neonatal period has been suggested as one of the main interventions needed to reduce neonatal mortality [18],

emphasizing the urgency and importance of reducing the first delay in care-seeking.

The second delay is the time it takes from once the decision to seek care is made until a health facility is reached. This delay involves the time of transportation, which depends on mode of transportation, road quality and distance, but also the economical considerations and an ability to pay.

The third delay is the time it takes from arrival at a health facility until appropriate and adequate care is commenced. This delay, often referred to as "Doctor's delay" is strongly related to the quality and effectiveness of the care institution. The time of delay is not overcome until "adequate care" is given, meaning that transfers within the health care system prolong the delay unless it can be assured to take place after care has been initiated and without compromise to care quality.

Thaddeus and Maine developed their conceptual framework for obstetric emergencies, but the same mechanisms are valid for preventive care-seeking for delivery, and Gabrysch and Campbell have expanded the framework to involve this aspect, as well (*Figure 5*) [77]. Gabrysch and Campbell acknowledge that the determinants of preventive care-seeking for delivery might not be the same as those in emergency situations, but the themes might be the same. Four themes to categorize determinants of care-seeking are presented: (1) socio-cultural factors, (2) perceptions, (3) economic accessibility and (4) physical accessibility. This framework is an application and illustration of the more general theory presented earlier (*Figure 3*) where the idea of structural and proximate determinants is applied in more detail to a specific event in relation to neonatal survival: care-seeking at delivery.

Socio-cultural factors of care-seeking

The socio-cultural factors relating to care-seeking presented by Gabrysch and Campbell can be found among both socioeconomic and proximate determinants in the framework described earlier (*Figure 3*). Ethnicity and religion, along with traditions, customs and beliefs influence the decision-making about how, when, and where to seek care [78-81]. In Vietnam, there is, for example, a widespread belief in traditional medicine, and in many instances these practices are tried before reaching the decision to seek care at a health facility.

Education is another socio-cultural factor that has been shown to be an important factor related to the first delay of care-seeking [82-84]. Maternal education is associated with all sorts of health care behavior, and the mechanisms for this have multiple explanations. One argument is that higher education leads not only to more knowledge, but also to the ability to adopt to and process new information [54]. This results in a higher receptivity of
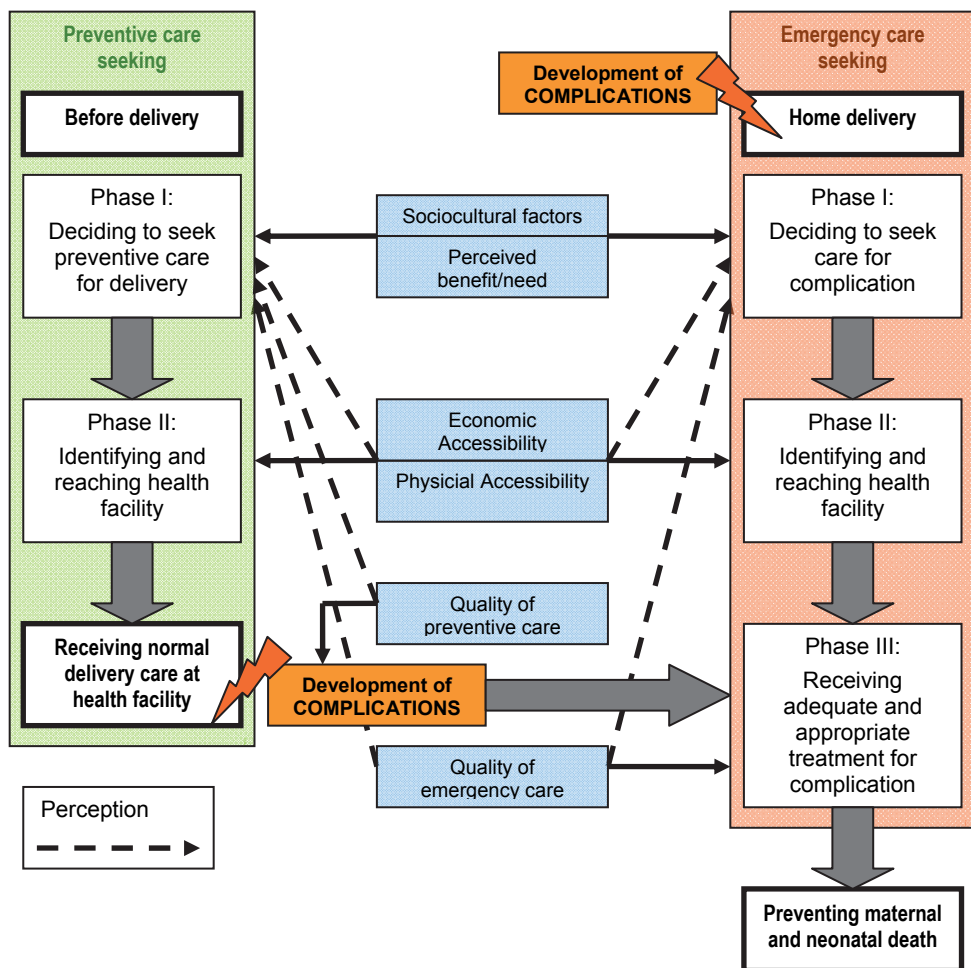
Figure 5. Delay phases and factors affecting use of delivery care and maternal mortality (adapted from Thaddeus and Maine) [77].

health messages and increased understanding of preventive care. Educated women also have a higher status in the household, on average, and thereby a greater decision-making potential, better communication within the family, and higher economic independence [85, 86].

Among the proximate determinants, we find maternal age, martial status, family structure, level of female emancipation etc. Women of older age might have more decision-making power in the household, be more confident and experienced, which might lead to a better pattern of health care utilization [78, 87]. Martial status is not as strongly associated with health care use during pregnancy or at delivery as maternal age, but a few studies have shown an association [88, 89].

There are, of course, many other factors attributed to socio-economy and culture not mentioned here, but the main idea is to consider the possible influence of these factors and to acknowledge the complexity of the decision-making process that is necessary to overcome the first delay of care-seeking.

Perceptions

When making the decision to seek care, whether in an emergency situation or when planning for delivery, the perceptions of advantages and possible outcomes of sought care play an important role. The first dimension relates to the woman's perception for the need to seek care, which is closely linked to knowledge about the severity of certain conditions or the benefits of preventive care. Ideas and perceptions of the quality of care that will be provided if there is a decision to seek care, based on rumors or previous experiences, greatly influence the first delay [74]. In the same way, perceptions about travel time and the hazards of transportation are influencing the choices. The perceptions and expectations about the delivery care can also be influenced by antenatal care (ANC), with more prenatal visits, which thereby increase the likelihood of a health facility delivery [82]. All are illustrated by dotted arrows in the figure (*Figure 5*).

Quality of delivery care is not only a question about staff's knowledge and experience, but also depends on staff attitudes. There are many examples in the literature of women reporting dissatisfaction with rude and arrogant health staff [80, 90, 91]. This could also be a source of discrimination against ethnic minorities and other marginalized groups, thus functioning as a cause of inequity in health.

Economical accessibility

Many studies deal with user fees in health care – and delivery care is no exception [92, 93]. But the costs for delivery are not limited to admission fees and transportation costs. Informal payments must be taken into the calculation, as well. The impact of costs on care-seeking is, however, disputed. Thaddeus and Maine point out that the perceived quality of care overrides the barrier of high costs as a decisive factor [74]. Lower costs for delivery do however play an important role [94, 95], even if there is evidence that reducing the costs for delivery care is not of major importance to change care-seeking behavior [96].

Physical accessibility

Physical accessibility is directly affecting the second delay, but the perceptions of how to get to the health facility also plays an important role in

the decision to seek care [77]. Geographical factors such as distance and living area are suggested to influence the choice of delivery place [77] and to be determinants of neonatal mortality [52]. Geographical distance has, for example, been demonstrated to influence health care-seeking and utilization, with less usage of health services the longer the distance to a health facility. This phenomena, often called the distance-decay effect [97], has been described for various situations and patient categories [98-101]. The distance-decay effect has also been presented for the utilization of delivery and maternal health care [102-105].

Distance is, however, a complicated concept, and is not easily measured due to the complexity of reality. Many factors, like elevation, road quality, seasonal flooding and temporary road blocks must be taken into consideration if the true distance should be measured. Simpler measurements, like Euclidian (straight-line) distances or two dimensional road distances, are therefore often used as proxies for the thought true distance. But even if the true distance in meters would be possible to quantify, not all subjects are travelling with the same speed (depending on external factors like mode of transportation, weather or administrative regulations). Shannon and colleagues argue that what actually counts is the total effort made to reach a health facility and suggest that perceived travel time could be a good approximation of this effort [97]. Travel time is then directly related to the second delay while the perception of the effort, including all factors influencing travel, is significant for the first delay of care-seeking.

Living area has also been suggested to be a part of physical accessibility [77]. Usually comparisons between urban and rural areas are made, but also differences between regions have been investigated. Most common is to find a higher use of health services in urban areas [106, 107], much explained by the distance-decay effect, but also as a function of demographic distributions of education, wealth and ethnicity.

Geographical Information Systems (GIS) can be used to investigate the geographical components of physical accessibility, such as distance and area. The use of GIS is becoming more common in health research as the technique develops [108]. It can be used both for surveillance, for example the monitoring of such infectious diseases as malaria and acute respiratory infections (ARI) [108-110], and for planning, using cluster analyses [111] and other mapping techniques.

Aims

Neonatal mortality has long been a neglected problem in the world, with stagnant development over the past decades. Previous studies within our research group have verified this limited development in Vietnam, with persistent neonatal mortality despite major improvements in overall under-five survival. The Vietnamese setting is thus offering a model for the exploration of obstacles for improved neonatal survival. Such obstacles can be found in societal structures as well as in patterns of behavior at an individual level. Stimulating development requires the acquisition of reliable data as well as a proper understanding of socioeconomic and proximate determinants of neonatal death. The overall aim of this thesis was therefore to study and assess factors associated with neonatal mortality, with special emphasis on structures within society and the health care system in Quang Ninh province.

Specific aims
1. To analyze the rate and sources of information on neonatal mortality (Study I).
2. To identify and assess socioeconomic and proximate determinants of neonatal mortality (Study II).
3. To investigate the impact of care-seeking patterns, place of delivery and transfer patterns on neonatal mortality (Study III and IV).
4. To investigate if geographical distance to health facilities influences neonatal survival (Study IV).

Methods

NeoKIP

This thesis is part of a population based cluster randomized study called NeoKIP (Neonatal Health – Knowledge Into Practice, ISRCTN44599712), initiated by Uppsala University in Sweden, the Ministry of Health in Vietnam and the Vietnam – Sweden hospital in Uong Bi, Vietnam. A baseline survey in the whole province was performed in 2006, registering all births and neonatal deaths occurring in 2005. The intervention of the NeoKIP study commenced in July 2008.

Study setting

Quang Ninh province is situated in the north-east corner of Vietnam, bordering China in the north. The province inhabits a little more than a million people and is currently undergoing rapid economic development. The ethnic pattern is diverse in Vietnam, with a multitude of ethnic minority groupings, mostly defined by language and culture. In Quang Ninh province, there are ten different ethnic groups (Kinh, Dao, San Chi, San Diu, Tay, Hoa, Cao Lang, Thanh Y, Thanh Phan and Chinee), with Kinh being the majority group constituting about 80 % of the population [31]. There are 14 districts in Quang Ninh province, of these, eight districts had a neonatal mortality rate (NMR) higher than 15/1000 (2005) according to NeoKIP baseline results, and were identified and chosen to constitute the study area (*Figure 6*). Roughly 6 500 births occur each year in these eight districts, and the NMR for the entire study area was 24/1000 in 2005 [112].

Health care system

The health care system in Quang Ninh province follows the national guidelines, with at least one community health center (CHC) in each community and one district hospital (DH) in all district centers. In Ha Long City, the administrative center of the province, there is a newly built provincial hospital with referral capacity, and in Uong Bi there is a regional hospital serving not only Quang Ninh, but also the surrounding provinces.
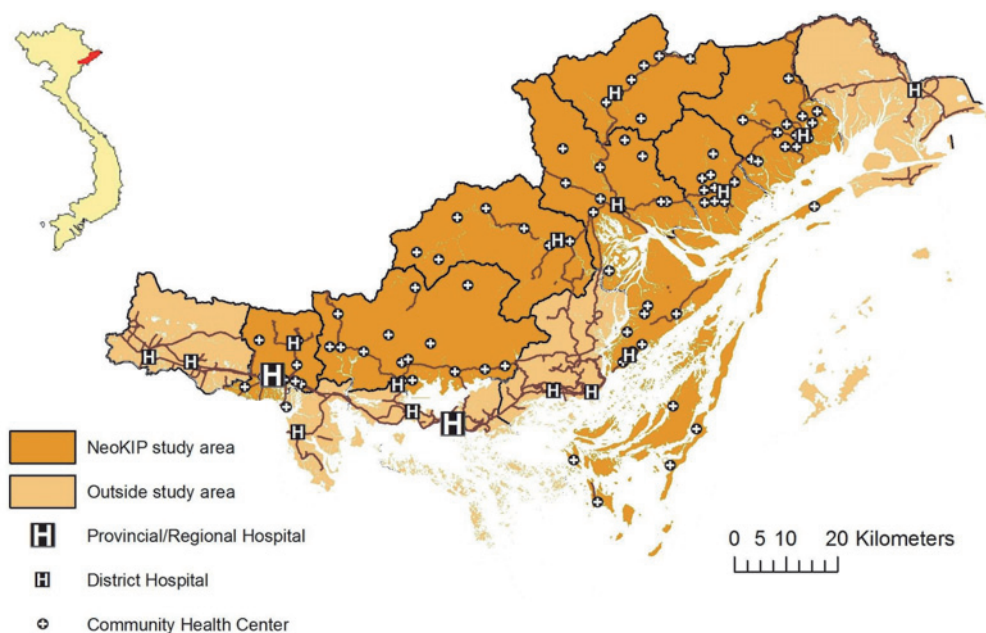
Figure 6. Quang Ninh province in northern Vietnam.

Administrative bodies are parallel to health facilities with a Provincial Health Bureau (PHB) in Ha Long and District Health Bureaus (DHB) at each district center. All CHCs and DHs report to the corresponding DHB and the provincial hospital is managed by the PHB. The Vietnam – Sweden General Hospital (UBGH) in Uong Bi is, on the other hand, directly subordinated to the Ministry of Health in Hanoi. Aside from the governmental health facilities, there are three hospitals run by coal mining companies.

Women are free to go for antenatal care at any provider and there are many private ANC providers in the province, many of them specialized in ultrasound examinations. There are no private delivery care providers in QN.

Data reporting system

The midwife at each CHC is responsible for monitoring and reporting all reproductive health events in the commune, as well as the monthly report to the DHB. Parallel to this organization, there is a Maternal and Child Health Network (MCHN) under the PHB, which is working with preventive care and information gathering about reproductive health. The reports from these two sources are merged at the PHB, which later passes it on to the MoH and the national statistics. The regional hospital in Uong Bi (UBGH) is,

34

however, reporting their activities directly to the MoH. Newborns delivered at UBGH are not reported to the PHB, but should instead be noted by the midwife at the local CHC. The official reporting system is admittedly poor due to lack of coordination and vital registration systems, and national statistics, for example WHO figures, are mostly depending on information from the Demographic Health Surveys (DHS).

Study designs, population and sample size

Studies I and III in this thesis have analyzed data from the NeoKIP baseline study, performed in early 2006. Study I used a retrospective cross-sectional design registering all live births (n = 17 519) and neonatal deaths (n = 284) that occurred within the province during 2005. The neonatal mortality rates thus retrieved were compared to the official statistics reported to the MoH.

In study III, data from the baseline survey were examined further, looking at the cohort of neonatal mortality cases (n = 284). Delivery narratives were collected from mothers who had lost a child during the first month after delivery, and a quantitative analysis of care-seeking patterns and place of delivery was performed.

Studies II and IV have used data from the NeoKIP intervention database, applying a case-referent design. All mothers within the NeoKIP study area who lost a newborn during the first month after delivery and during the time

Table 1. Study methods used in different manuscripts.

	Study design	Sample size	Exposure	Outcomes
Study I	Cross sectional	17 519 live births	Neonatal mortality	Neonatal mortality rate and rate of under-reporting
Study II	Case-referent	183 mortality cases and 599 referents	Ethnicity, education, economic status and family structure	Neonatal mortality
Study III	Retrospective cohort study	284 cases of neonatal mortality	Care-seeking and delivery care utilization	Care seeking pattern and time of neonatal death
Study IV	Case-referent and spatial analysis	183 mortality cases and 599 referents	Care-seeking and delivery care utilization	Neonatal mortality

period form July 2008 to December 2009 (study II and IV) (n = 197) were approached for interview and 183 were available for interview. During interviews a semi-structured interview form was used. The same interview form was used to interview referent mothers randomly selected from the total population of live births.

Study II focused on determinants of neonatal mortality, analyzing both socioeconomic as well as proximate determinants. Study IV analyzed care-seeking patterns in relation to delivery as well as the final place of delivery in order to identify risk behaviors and potential intervention points. This analysis also used a case-referent design comparing mortality cases with referents, with the addition of a spatial analysis using GIS data.

Data collection

Baseline

In the baseline survey, data collection was mainly performed by compiling variables associated with deliveries and neonatal deaths. This information was derived from two major sources, health registers at all level of the health system and through group interviews with village health workers. The WHO definitions of neonatal death and stillbirths were used by the NeoKIP data collectors to distinguish between death cases. Neonatal deaths were recorded by age, place of and assistance at delivery, place of death, birth weight, gestational age at birth, and gender. When a death case was found through any source, checking against the other sources on different levels was performed to verify each case.

Whenever a neonatal death was identified during baseline, the narrative of delivery was collected from various sources. Midwifes, village health workers and other informants were asked open-ended questions on details about the road to delivery.

Intervention

During intervention, a team of data collectors recorded all live births in the study area on a monthly basis, visiting health facilities and village health workers. All live births were entered into a database and once a month all new entries were grouped and assigned a number. By the use of a random number generator 6 % from each batch were selected as referents. With an estimated NMR of 20-25/1000 a randomization of 6 % for referent interview assured at least a 2:1 ratio between referents and cases.

Data collectors visited all sample mothers in their homes eight to ten weeks after delivery and conducted a semi-structured interview, gathering

information about antenatal, delivery and postnatal care, as well as socioeconomic factors.

Asset index

From the results of interviews, an asset index was developed using principal component analysis in order to assess economic status of respondents' household. This was done by an inventory of fifteen different assets and household characteristics conducted in the homes of interviewees (motorbike, car, stereo, TV, DVD/VHS, refrigerator, washing machine, gas stove, electrical stove, electric fan, AC, glass windows, flush toilet, running water, and whether or not the household was connected to the power grid).

Geographical Information System (GIS)

GIS coordinates were collected by the use of handheld GPS devices (Garmin GPS 60 or Garmin GPS 60Cx). All governmental health facilities and homes of respondents were recorded and entered into the database. Geographic background information was obtained from VidaGIS, a Vietnamese-Danish commercial GIS provider. Relevant data obtained from VidaGIS consisted of:

1. Roads: main and small
2. Waterways and riverlands
3. Administrative borders: province, district and commune levels
4. Elevation curves

Statistical analysis

Study I and III used a descriptive analysis, including calculations of NMR, and the corresponding 95 % confidence intervals (CI). Chi-square tests were performed to compare groups stratified according to socioeconomic factors.

In study II and IV logistic regression and principal component analysis were used. Odds ratios (OR) along with 95 % confidence intervals were calculated. Mann-Whitney U test and Chi-square tests were used to compare groups.

In study IV, straight-line distances and manually measured road distances were obtained based on GIS data collected within the NeoKIP project as well as from VidaGIS data base of topographic information.

All statistical analyses were performed in Intercooled Stata (version 9.2, StataCorp LP, College station, Texas, USA) and SPSS (version 14.0 (Study I and III) and 17.0 (Study II and IV), SPSS Inc, Chicago, Illinois, USA). Geographical software used was ArcGIS (version 9.3, ESRI, Redlands, California, USA).

Ethical considerations

The research presented in this thesis was conducted within the NeoKIP study, which has been approved by the Ministry of Health in Vietnam (ref 3934/QD-BYT), the Provincial Health Bureau in Quang Ninh and the Research Ethics Committee at Uppsala University, Sweden (ref 2005:319). The studies of this thesis are not concerned with the impact of the ongoing intervention, and are thus not affected by ethical issues relating to interventions and controls. Instead, there are two major ethical concerns in this thesis, firstly the question of integrity and secondly the obligation to disseminate and act on results.

Study I and III used only data obtained from the registers within the health system and from employed health workers. Anonymity of subjects was secured through depersonalization of data at an early stage of data handling. Study II and IV were based on data obtained through interviews with mothers according to the study protocol. Informed oral consent was obtained from all respondents prior to interview. The response rate was high and only few mothers declined an interview. The reason for this might be found in the Vietnamese culture with a strong emphasis on hierarchical structures in which it is difficult to refuse something ordered from a higher level. This issue was, however, discussed within the research group. The fact that the interviews were completely voluntary was stressed when asking for oral consent. Depersonalization of the data was performed before analysis.

Study results have been disseminated at conferences and through peer-reviewed journals. Reports back to the health care system in Quang Ninh have been performed continuously through workshops and direct communication.

Results

The main findings across the four articles in this thesis highlight structural obstacles to neonatal survival. These include both the structures within society – when ethnicity and education are decisive for the newborn health – and structures of the health system, such as a faulty data reporting system, inadequate care-seeking patterns, and disparities in access.

Under-reporting of births and deaths (Study I)

Before the NeoKIP baseline, the official figures on neonatal mortality given by the Provincial Health Bureau were an annual NMR of 4/1000. Vietnam has been acknowledged in the global community as a country having managed to present good health statistics considering its economical status. A NMR of 4/1000 seemed unlikely, however, and there was a need to validate these statistics. During the NeoKIP baseline, 17 519 live births and 284 neonatal deaths were registered to have occurred in Quang Ninh province in 2005. This resulted in a NMR of 16/1000, thus four times higher than the official statistics.

Table 2. Births and neonatal deaths in official statistics and in NeoKIP baseline in Quang Ninh province, Vietnam, 2005.

	Births	Whereof home	Neonatal deaths	NMR	95 % CI
Official statistics	16 551	854	70	4.2	3.2 – 5.3
NeoKIP baseline	17 519	1 461	284	16	14 – 18

This substantial under-reporting was unevenly spread among the different districts of the province, with a varying degree of discrepancy between official figures and NeoKIP baseline results (*Figure 7*).

There was also an under-reporting of live births in the province. The official records had registered 16 551 live births occurring in 2005, whereas the NeoKIP baseline registered an extra 968 live births. Most of these extra births were delivered at home, and the home delivery rate reported by official sources and NeoKIP was 5.2 % (854/16551) to 8.3 % (1461/17519) respectively.
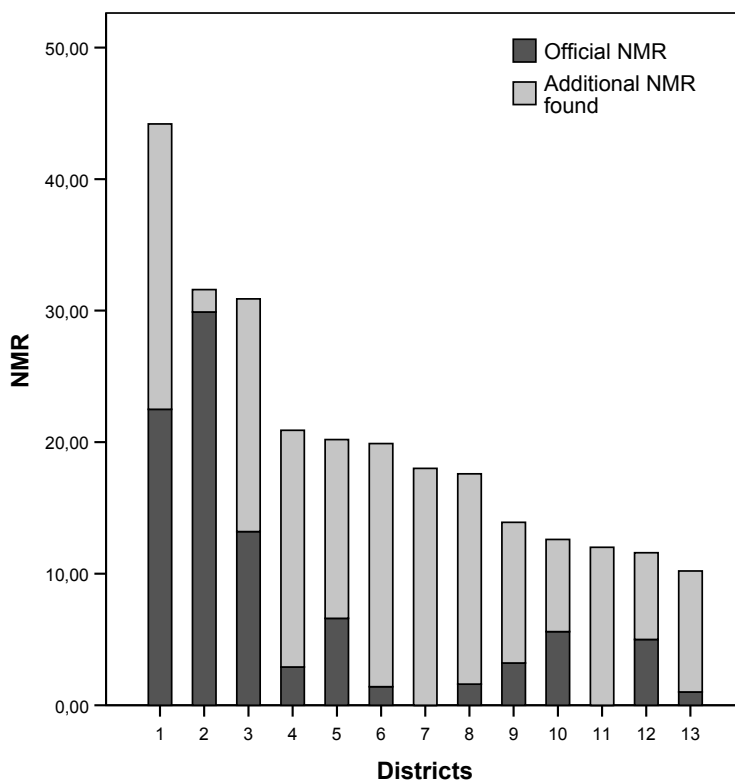
Figure 7. Neonatal mortality rate (NMR) stratified according to districts in Quang Ninh province, Vietnam, revealing the extent of invisible neonatal mortality. Due to small size, two districts were merged in the analysis, resulting in 13 sub-entities.

Determinants of neonatal mortality (Study II and IV)

Studies II and IV investigated determinants of neonatal mortality through a case-referent study design. All neonatal deaths during eighteen months (July 2008 to December 2009) in QN were registered as cases (n = 197) and six percent of all live births during the same period were randomly chosen as referents (n = 686). The mothers of these cases and referents were then interviewed by the use of a semi-structured interview form collecting data on different variables possibly affecting neonatal survival. Mothers of one hundred and eighty-three (183) cases and 599 referents responded. Mean age of case mothers was 24.1 years and for referent mothers 25.4 years (p < 0.001).

Socioeconomic determinants

Ethnic belonging of mother, maternal and paternal education level and household economic status were ascertained.

Ethnicity

Ethnic minority mothers constituted 38 % of referent mothers (228/599) and 63 % (130/183) of case mothers. This resulted in an elevated risk of neonatal mortality for ethnic minority mothers (COR 2.75, 95 % CI 1.94 – 3.91).

Education

Maternal and paternal education co-varied and hence maternal education level was used alone. A larger proportion of case mothers had not completed primary school (less than five years) (29 %) compared to referent mothers (18 %). There were no differences in neonatal mortality risks between different levels of education once mothers had completed primary school. There was, however, an increased risk for mothers who had not attended school, or done so less than five years, compared to mothers who at least had finished primary school (*Figure 8*).
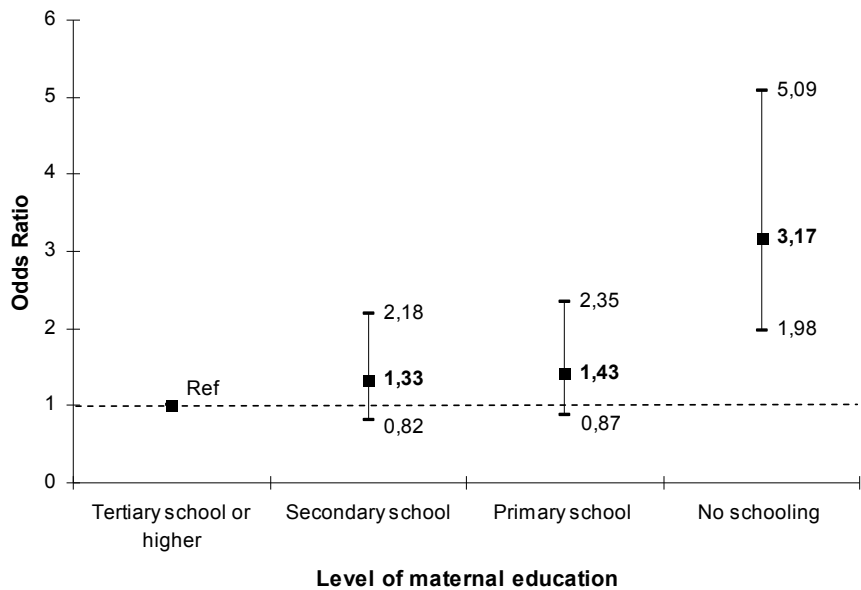

Figure 8. Crude odds ratios (COR) for neonatal mortality by maternal education levels in Quang Ninh province, Vietnam. Tertiary school or higher set as reference. Whiskers representing 95 % confidence intervals.

Economy

Referent interviews were used to generate an asset index using primary component analysis (Table 3). After an initial analysis, "bike" and "radio" was dropped due to low explanatory power. The asset index was defined as the sum of the factor score for each asset. Since the asset variables are dichotomous, the ownership of one of the assets changes the asset index by factor score divided by its standard deviation, normalized by the mean of each asset.

Table 3. Mean, standard deviation, and factor scores of asset variables used to calculate asset index.

Asset	Mean ($\bar{x}$)	Std. Dev (s_1)	Factor score (f_1)	Owning $(1-\bar{x}) f_1/s_1$	Not owning $(0-\bar{x}) f_1/s_1$
Motorbike	0.7980	0.3106	0.1931	0.1256	-0.4960
Car	0.0200	0.1084	0.1405	1.2700	-0.0260
Stereo	0.1486	0.2752	0.1574	0.4870	-0.0850
TV	0.8581	0.2700	0.2541	0.1335	-0.8076
DVD	0.6511	0.3688	0.2702	0.2556	-0.4770
Refrigerator	0.3422	0.3671	0.3614	0.6475	-0.3369
Washing machine	0.1369	0.2660	0.3206	1.0404	-0.1650
Gas stove	0.3656	0.3726	0.3395	0.5780	-0.3331
Electrical stove	0.1436	0.2713	0.1455	0.4593	-0.0770
AC	0.0701	0.1976	0.2608	1.2275	-0.0926
Fan	0.8664	0.2632	0.2286	0.1160	-0.7525
Glass windows	0.2654	0.3417	0.3184	0.6846	-0.2474
Flush toilet	0.4057	0.3799	0.3538	0.5535	-0.3778
Power grid	0.9232	0.2060	0.1786	0.0666	-0.8003
Running water	0.3456	0.3680	0.1791	0.3185	-0.1682

By applying the generated asset index, sample households were classified into five quintiles. Households were labeled as "poor" when having an asset index score of less than −2.079, representing the cut-off point of the 20th percentile among referent mothers. Referents were divided into quintiles and the lowest quintile was labeled as "poor" (Table 4).

Table 4. Means of asset index for referent and case mothers, overall and by quintiles.

	Mean	Min	Max	Q1	Q2	Q3	Q4	Q5
Referents	0.000	-5.24	7.96	-3.316	-1.575	-0.518	1.319	4.167
Cases	-1.501	-5.24	4.59	-3.691	-1.447	-0.333	1.177	3.310

There was an increasing risk of neonatal mortality with declining economic status. The poorest quintile had a more than five-fold risk of neonatal mortality compared to the richest quintile (COR 5.41 CI 95 % 2.69 – 10.9) (*Figure 9*). When dichotomizing the wealth quintiles into poor and non-poor there was a more than double risk for newborns of mothers from poor households compared to the non-poor to die within the first month after delivery (COR 2.21 CI 95 % 1.53 – 3.18).
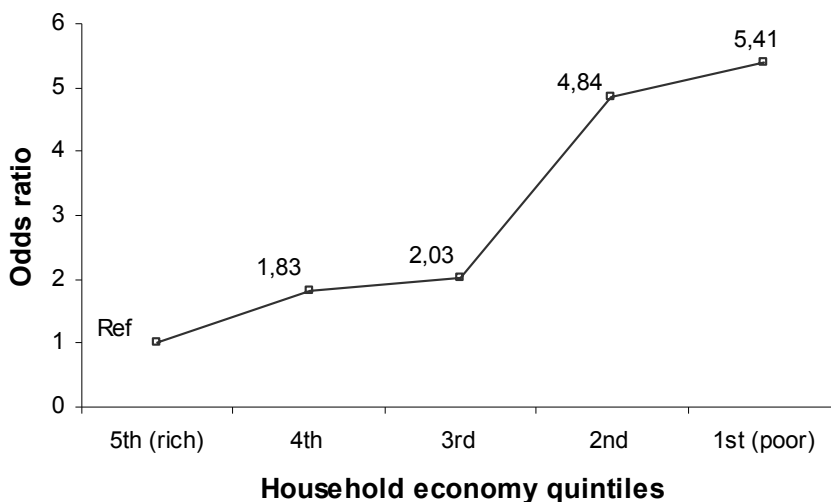
Figure 9. Crude odds ratio (COR) for neonatal mortality over household economy quintiles in Quang Ninh province, Vietnam.

Socioeconomic determinants combined

When combining ethnicity, education and economic status in a multivariate logistic regression model, an increased risk of neonatal mortality was shown for ethnic minority mothers and mothers with low education, but could not be confirmed for mothers from poor households (Table 5).

Table 5. Multivariate logistic regression model with maternal ethnicity, household economic status and maternal education with adjusted odds ratios for neonatal mortality in Quang Ninh province, Vietnam. An asset score below the 20th percentile was considered poor. Primary school or higher completed representing $\geq$ 5 years of schooling.

	Ref (n)	Cases (n)	OR	CI 95 %
Kinh	370	67	Ref	
Minority	228	114	2.08[†]	1.39 – 3.10
Non-Poor	476	116	Ref	
Poor	122	65	1.28	0.84 – 1.94
Primary school or higher	492	116	Ref	
No primary school	106	65	1.65*	1.08 – 2.53

* p < 0.05, [†]p < 0.001

Proximate determinants

In a first analysis of the proximate variables investigated, ANC attendance, delivery place and distance to the closest health facility showed an association with neonatal mortality. Even if it has been previously noted in the literature, there was neither increased risk for young or old mothers in our material, nor was parity associated with neonatal mortality. Family structure and martial status were investigated as well, but showed no association with the outcome.

ANC and delivery care utilization

Mothers who had not attended any antenatal check-ups had a more than threefold risk of neonatal mortality (COR 3.45 CI 95 % 2.35 – 5.06) compared to mothers who had attended at least one ANC visit. Likewise, there was an increased risk for newborns to die before reaching one month of age if the mother delivered at home (COR 3.01, 95 % CI 2.02 – 4.49) compared to a health facility delivery. The question of who assisted at delivery was also asked. There was, however, difficulty in retrospectively valuing the skills of those attending birth, so this variable was omitted from the analysis.

Distance to health facilities

GIS coordinates for the homes of 597 referents and 180 cases were recorded. Straight-line distances from respondents' homes and all health facilities were calculated as exhibited in Table 6. Most mothers lived closest to a CHC. Distances to the closest health facility among different levels of the health system were divided into quintiles based on data from referents. The

40 percent living farthest away were labeled as being "remote" compared to the rest that were labeled as "close". There was an increased risk of neonatal mortality for mothers living farthest away (COR 1.96 CI 95 % 1.39 – 2.75) from any health facility.

Table 6. Median straight line distance from respondent's home to health facilities in Quang Ninh province, Vietnam, overall and in groups based on delivery place and outcome.

	Distance to Closest Health Facility	Distance to CHC	Distance to District Hospital	Distance to Tertiary Hospital
Cases	1 437	1 440	7 242	63 419
Referents	997	1 060	6 386	41 635
	p < 0.001	*p < 0.001*	*p ≤ 0.01*	*p < 0.001*

Proximate determinants combined

In the first step of analysis of the proximate determinants, three variables were associated with neonatal mortality: place of delivery, antenatal care attendance, and distance to health facilities. When combining these in a multivariate logistic model, all three were still associated with neonatal mortality (Table 7). It can, however, be argued that these variables are all in the casual pathway of neonatal mortality and should thus not be combined in the same multivariate model. Nevertheless, by doing so and still maintaining the association to neonatal mortality hints to the individual impact of each variable. Furthermore, mothers who did not attend antenatal care and who also delivered at home were at an even higher risk of experiencing neonatal mortality (OR 4.79 CI 95 % 2.98 – 7.71).

Table 7. Multivariate logistic regression model with proximate determinant of neonatal mortality in NeoKIP study area in Quang Ninh province, Vietnam.

	Ref (n)	Cases (n)	OR	CI 95 %
Health facility delivery	518	123	Ref	
Home delivery	79	57	1.63	1.01 – 2.65
ANC attendance	506	113	Ref	
No ANC attendance	91	68	2.38	1.51 – 3.75
Close to any health facility	358	78	Ref	
Remote from any health facility	239	102	1.47	1.03 – 2.11

Stratification

In order to handle confounders, there are two main strategies, either by adjusting for possible confounding variables in a regression model or by stratification. Adjusting for confounders is a plausible way if the different variables are thought to be at the same level in the explanatory model. If, however, distal variables would be adjusted for proximate variables, the effects of each variable might be reduced or eliminated [50], as previously argued. To free oneself from the confounding effect, stratification must instead be applied.

We have thus far demonstrated the association of the distal socioeconomic variables, ethnicity and education, and of three different proximate variables (place of delivery, antenatal care and distance to health) to neonatal mortality. When stratifying by ethnicity, there are still associations between the proximate variables and neonatal mortality (Table 8). A similar pattern was seen when stratifying by education (data not shown).

Table 8. Odds Ratios (OR) for neonatal mortality risks in NeoKIP study area in Quang Ninh province, Vietnam, related to delivery place, ANC attendance and distance to health facility, divided by ethnic belonging.

		OR	CI 95 %	OR	CI 95 %
Ethnicity	**Distance to closest health facility**				
Kinh	Close	Ref			
	Remote	1.31	0.75 – 2.27		
Minority	Close	2.12	1.27 – 3.54	Ref	
	Remote	3.46	2.24 – 5.35	1.61	0.99 – 2.62
Ethnicity	**ANC visit**				
Kinh	Yes	Ref			
	No	1.14	0.45 – 2.87		
Minority	Yes	1.73	1.14 – 2.62	Ref	
	No	5.52	3.45 – 8.82	3.20	1.97 – 5.20
Ethnicity	**Place of delivery**				
Kinh	Health facility	Ref			
	Home	0.91	0.11 – 7.68		
Minority	Health facility	2.05	1.37 – 3.07	Ref	
	Home	4.20	2.67 – 6.59	2.05	1.28 – 3.26

Care-seeking and delivery care utilization (Study III and IV)

Place of delivery

In the previous section, it was demonstrated that the place of delivery is a major determinant of neonatal survival, whether the delivery took place at a health facility or at home. When dividing the place of delivery by the different levels of the health care system there were no differences in mortality depending on which health care level the delivery took place (Table 9).

Table 9. Neonatal mortality rates by place of delivery care calculated from total number of live births and neonatal deaths from baseline and intervention periods in Quang Ninh province, Vietnam. Odds ratios for neonatal mortality based on cases and referents.

	Baseline period 2005 (Study III)	Intervention period 07/2008 – 12/2009 (Study IV)		
Place of delivery	NMR (95 % CI)	NMR (95 % CI)	OR	95 % CI
Regional/Provincial hospital	19 (15 – 23)	12 (7.7 – 17)	Ref	
District hospital	12 (10 – 15)	14 (10 – 19)	1.11	0.71 – 1.73
CHC	7.5 (4.6 – 11)	7.6 (3.5 – 14)	0.59	0.30 – 1.18
Home	38 (29 – 49)	52 (38 – 70)	2.98	1.79 – 4.96

Care-seeking at delivery

In the NeoKIP baseline, 284 neonatal death cases were identified. In order to explore the care-seeking patterns and the road to delivery for these cases, narratives of what happened in connection to delivery was collected from informants within the health system. In this way, 206 narratives were collected. Based on the collected narratives, mothers were grouped according to the first contact they had with the health system at the time of delivery. The result showed an even distribution at the different levels of the health system for this primary care-seeking at delivery, with 44 mothers seeking delivery care at a tertiary hospital, 56 at a district hospital, 51 at a CHC and 54 choosing to deliver at home, whereas 12 did so assisted by a midwife from the local CHC. Among cases from the intervention period a similar distribution was found with 19 mothers seeking delivery care at a

tertiary hospital, 30 at a district hospital and 31 at a CHC, while 39 chose to deliver at home. There was no difference between cases and referents whether they had gone to the closest health facility or chose to go to a more distant health facility for delivery (χ^2 0.3085, p = 0.58).

In study IV the effect of distance to health facilities on care-seeking behavior was investigated. There was sharp distance decay in delivery care utilization both among cases and referents (*Figure 10*).
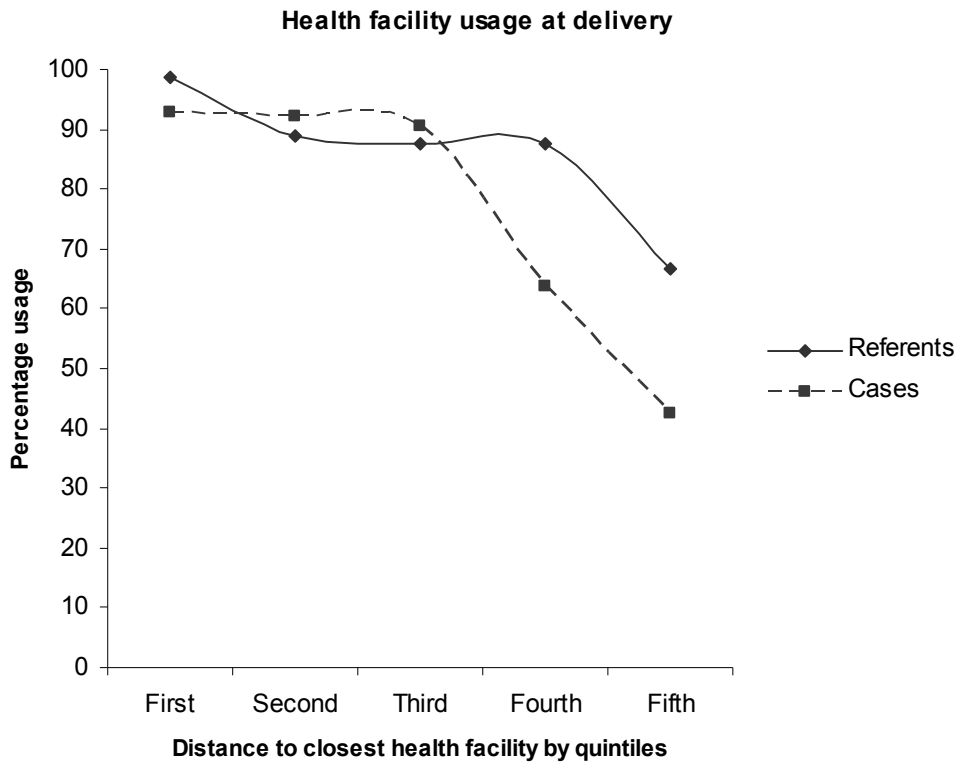
Health facility usage at delivery

Figure 10. Health facility usage at delivery based on the distance from mother's residence to the closest health facility in Quang Ninh province, Vietnam. (1st quintile < 401 meters, 5th quintile > 2233 meters).

The road to death

Among the neonatal death cases in study III 37 out of 155 were transferred post partum, rendering a transfer rate of 24 %. Among cases in study IV, the transfer rate was 68 % (20/29), a discrepancy most likely due to different study populations, with the former including a higher urban proportion already delivering at the major reference hospitals. When it comes to time of

death, there was, however, a similar pattern between the two populations, with a decreasing proportion of very early neonatal death with the higher level of health care system where the mother first sought care (*Figure 11*).
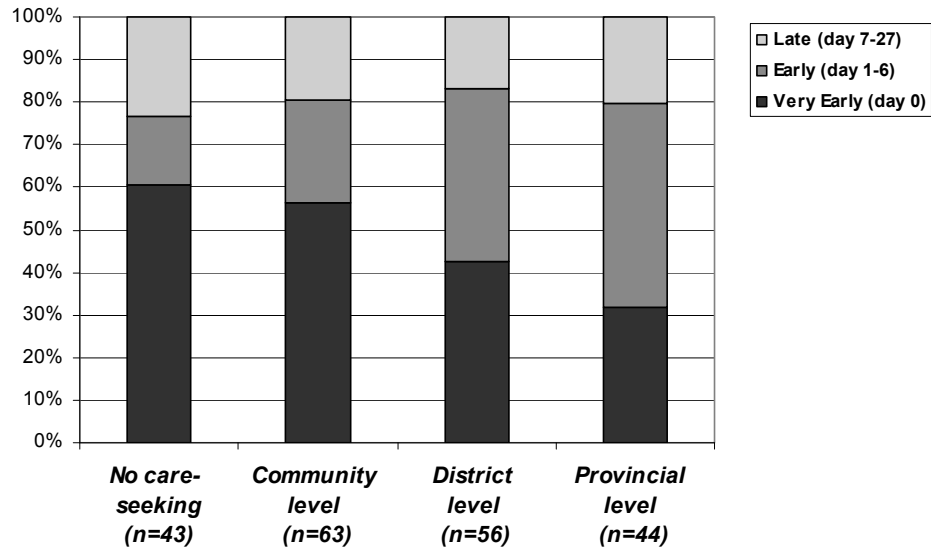

Figure 11. Levels of primary care seeking at delivery distributed over time period of death among neonatal mortality cases in Quang Ninh province, Vietnam in 2005.

In study III most of the newborns (68 %) who died in the neonatal period remained in the care of the health care system between delivery and death, and most of them died at the place of delivery. Twenty cases were discharged from the health care system before death, and together with the 39 newborns who did not have any contact with the health care system they constituted a quarter of all neonatal cases (25 %).

Discussion

The results from the four studies presented here highlight different structural obstacles for improved neonatal survival in Quang Ninh province, Vietnam. A faulty data reporting system hides the magnitude of the problem and obstructs evaluation of interventions made. Group differences based on ethnicity, with ethnic minority mothers at a marked increased risk of neonatal mortality, are grounded in societal structures and may be difficult to fully understand and target. And finally, the results demonstrate how physical access and geography influence survival chances for newborns.

Consequences of under-reporting

The first structural obstacle on the road to better neonatal survival is the lack of valid statistics [113]. This is not an isolated problem for Vietnam, but has been described from many places and settings [47, 114-119]. In the Vietnamese setting, there seems to be various reasons why births and neonatal deaths are under-reported. These range from a poor understanding among health staff, regarding the rationale and importance for adequate statistics, to systematic errors within the health care system. Utmost, however, is the question of responsibility and in the Vietnamese setting the responsibility is put on the family when it comes to registering births and deaths. There are multiple reasons why the family is not always interested in reporting such events. Further, a living newborn who has died before it has been registered as a birth might not be reported as a death. Even if there has been a relaxation in the Vietnamese family planning laws that are now advocating a "small family size" policy, the norm of one to two children may be a cause for the third and subsequent children to go unreported [36]. If, instead, the reporting of births and deaths was fully the responsibility of the health system, our results indicate that the level of accuracy would increase considerably.

The problem with under-reporting neonatal deaths may have severe consequences. In panel 1, some of the observed and possible consequences of a poor registration system are exhibited. At national and provincial levels, the low neonatal mortality rates will be misleading for policy and decision-makers and health plans will not be able to target those most in need. At the local level, the faulty statistics will preserve status quo by keeping the

problem invisible. Families and local health staff will not perceive the neonatal period as a time of enhanced risk for the newborn and will not see the need to take the necessary precautions to improve delivery or postnatal care. To raise awareness about the problem of neonatal mortality and the possible solutions have been shown as a viable way to improve neonatal survival, especially in high mortality settings [19, 22]. These efforts have each involved an assessment of the current situation, something that is easier with valid statistics.

Panel 1. Possible consequences of poor registration systems on neonatal health.

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International and national level

- The magnitude of neonatal mortality in the country is underestimated, and the flow of resources from major stake-holders is misguided.
- The monitoring of indicators for the Millennium Development Goals will be arbitrary without valid information.
- Targeting of interventions to those most in need will be impossible.

Regional and local level

- Awareness of neonatal mortality as a major health problem will be low, and interventions proved to reduce neonatal mortality will not be implemented.
- If any, measures taken to improve reproductive health will be inadequate since the interventions needed differ substantially between high and low mortality settings.
- At local level, the perinatal period will not be perceived as a period of increased risk for mother and child, resulting in poor preparations and precautions for pregnancy and delivery.

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Under-reporting is not only a matter of withheld interventions and lack of investments, but it is also a matter of human rights. According to the UN Convention on the Rights of the Child, to be registered at birth is a right for every child as an acknowledgement of humanhood [120]. To be visible in the statistics is to be part of society. Registering neonatal deaths in a systematic and honest way will further strengthen the position of all neonates by confirming their value as human beings. The enforcement of human rights is thereby an important part in the effort to improve neonatal survival [121].

Ethnic minorities at risk

Ethnic minorities in Quang Ninh province are at a higher risk of experiencing neonatal mortality than the majority group of Kinh. This increased risk is independent of the minority mother's education or the economic status of the household she lives in. Ethnic minorities in Vietnam are known to be marginalized, living in remote and mountainous areas [31, 32, 122]. It has also been shown that the ethnic minorities have benefited less from the economic development in recent years than the Kinh group, thus leaving them even more disadvantaged [122, 123]. Despite these economic and educational disadvantages, there seems to be more to ethnicity that explains the heightened risk of neonatal mortality. The proximate determinants health care utilization prior to and at delivery seems to be a plausible explanation for the discrepancy in survival between the majority and minority groups since ethnic minority mothers are more likely not to attend ANC and to deliver at home – which are well known and in the material presented here – as proven risk factors of neonatal death. However, even if the minority mother attends ANC or delivers at a health facility, she is at a higher risk of loosing her newborn in the first month. Therefore, a higher home delivery rate and less ANC are parts of the explanation (but do not represent the whole explanation). The remoteness of ethnic minority residences is often brought up as a reason for the disadvantages of minorities. It has, however, been argued that the development of a widening economic gap between the minority and majority is not only attributed to the remoteness of minority settlements, but is due to a combination of many social factors [124]. The results from study IV support this argument. When analyzing the distance from mothers' homes to the closest health facility, remoteness is still associated with neonatal mortality regardless of ethnic belonging.

What is demonstrated here is an example of horizontal inequity, as described and defined by Stewart [125]. Most often inequalities in society, whether in politics, economy or health, are measured from an individual or household perspective. This vertical inequality, measured over a range of individuals or households, omits the group dimension and the existence of inequalities between different culturally defined groups. Ethnicity, which is often defined as having a common history, language or tradition, may be a joining factor for such a group. Even if there might be large inequalities within the group, the difference between one culturally defined group relative to another may be a powerful preserver of status quo as well as a structural determinant that serves to explain differences in, for example, health outcomes. The universal human need to belong, by identification and affiliation with different groupings, inevitably leads to exclusion as a function to set and keep boundaries. This mechanism can be both internal within the group and external by people and groupings from outside. In this

case of neonatal mortality and health care utilization, the internal forces of ethnicity might cause the preservation of harmful traditions in newborn care. For example, there might be a certain cultural tenet within an ethnic grouping which forbids certain foods and nutritional intake during pregnancy, or there might be complete sets of traditions that relate to childbirth, like the Banthana practices described in India [126]. In Vietnam, the beliefs in traditional medicine are strong [31, 127], which could cause delay in seeking appropriate medical care. External forces of group belonging could, in this context, be any negative attitudes of health staff, discrimination against ethnic minority mothers (since ethnic minority markers might result in different treatment), as well as adverse attitudes in contacts with the health system. This is shown in the findings as an elevated risk for minority mothers even if delivering at a health facility. Finally, there are combinations and interactions of internal and external factors, where, for example, the choice of delivery place might be influenced not only by the mother's perceptions of how she is going to be received at a health facility (internal), but also by her previous experiences of staff attitudes and reception (external). Regardless of what the exact and true mechanisms are – which would be within the research field of a social anthropologist – the understanding of the concept 'horizontal inequality' will anyway be useful when trying to comprehend and explain the adverse health effects of ethnic minority belonging in this setting.

The geographical dimension

Geographical dimension, as a risk factor for neonatal death, has been investigated by an analysis of distance for mothers to reach the health system from their homes. As has been previously described, the concept of distance is a complex issue and is not easily measured. Yet, a rather simple measure such as straight-line distance yields a result, indicating an elevated risk of neonatal death for mothers living farthest away, independently of ethnicity, economy or education. The reasons for this circumstance are not revealed in the data and can only be speculated upon. The distances exhibited in this setting are comparatively short, as are the perceived times it took for mothers to actually reach a health facility for delivery. Nevertheless there was a larger proportion of very early deaths in the quintile living farthest away, indicating that time is crucial in intrapartum related deaths. In this setting, with seemingly small distances, there is a large variation in accessibility for the different areas, as well as in the ability to reach skilled attendance at birth (by its full definition) on time, which might be decisive for the survival chances of both mother and child.

A cluster analysis was also performed on the material in the case-referent study from NeoKIP intervention data. This analysis is not presented in the

articles of this thesis or in the results section, but showed two distinct clusters, one with an elevated risk in the mountainous district of Binh Lieu and one cluster with reduced risk close to the regional hospital in Uong Bi. Without going into further details of this analysis, it is worth mentioning that it underlines the geographical dimension in neonatal survival and suggests that proximity to the most advanced care is protective, thereby emphasizing the importance of quality of care at end points of the distance analysis. The health care system is well distributed in Vietnam, where much effort is made by the government for good coverage at the community level: in this material, good coverage is expressed as small distances to the closest health facility. Earlier research has described a lower level of knowledge about perinatal health issues among health staff in the more remote and mountainous areas where distances in general are longer [128]. This could be a confounding factor to the demonstrated association between the distance to closest health facility and neonatal mortality.

Methodological considerations

Case ascertainment

One of the major concerns when gathering data for the NeoKIP project has been to identify all neonatal cases, both within the entire province during baseline, and later in the study area during intervention. As was stated in study I, there is a substantial under-reporting of neonatal deaths in official statistics. The reasons for this are many, but some of the reasons pose problems, even if a separate data collection system is setup beside the official system.

"Achievement disease"

The lack of consistency and coordination of registers at different health facilities made it difficult to compare cases. Additionally, in Vietnam, there is a widespread attitude about the importance of showing good statistics, locally referred to as the "achievement disease". This also offers a strong force within the Communist and Confucian systems, where it is not allowed to criticize superiors and where goals are expected to be met. Many of the neonatal deaths occurring are due to poor competence and mishandling of health staff, and instead of requesting more training and resources the problem is hidden in order to avoid disgrace. Such "achievement disease" is sometimes so institutionalized that community health staff can be given directives from higher levels to tamper the reports. This behavior was evident during the NeoKIP baseline, when many of the books presented to the research team were obviously updated in close connection to the study visit to a given a CHC. This was especially true for such variables as home

visits made by the midwife, where the official decree is that all mothers should receive a home visit within the first week after delivery. In reality, almost no home visits are performed. To deal with this issue, a case-referent study design was applied in order to get all information directly from the mothers since the official registers could not be trusted. However, the problem with identifying neonatal deaths remained, and only through the use of a number of different sources (village health workers, admission registers, birth registers, mortality records etcetera) could an acceptable level of completeness be reached.

Defining neonatal deaths

When registering a perinatal health event, one of the problems is that of defining a neonatal death. Since such a large proportion of neonatal deaths occur intrapartum, it might sometimes be difficult to distinguish between a neonatal death and a stillbirth [71], and many early neonatal deaths are misclassified as stillbirths [129]. It has also been shown that neonatal deaths occurring in the first hours after birth or in small babies are less likely than other neonatal deaths to be reported [47, 130, 131]. A neonate must, by definition, be alive after birth before dying to be classified as a neonatal death event, even if life is just for a very short time. If the birth assistant is not receptive at the time of delivery, deciding whether or not the baby was a live birth or a stillbirth can be difficult.

Another complicating factor is the plethora of definitions and terminology. Birth asphyxia is a term that continues to be widely used for neonatal deaths occurring in connection to delivery. The word asphyxia is etymologically derived from the Greek word for pulseless, and is used for a syndrome combining hypoxia and metabolic acidosis [132]. It is, however, more often used for newborns that are not able to breathe properly for a variety of reasons, such as prematurity, a lack of proper resuscitation or even malformations. The imprecision of the term "birth asphyxia" has given rise to a plentitude of terms such as "perinatal asphyxia", "fetal distress", "hypoxic-ischemic encephalopathy" and "post-asphyxial encephalopathy" [71]. As noted, there is an interchangeable mixture between 'perinatal' and 'neonatal' in these terms, making it difficult to clearly define a neonatal death. At the same time, it bears witness to the difficulty in deciding on appropriate nomenclature. The nature of the problem is such that there have been three different consensus statements since 1996 that have suggested use of the phrase "neonatal deaths associated with acute intrapartum events" to replace the various terminology [133-135]. This phrase has not caught on, however, due to its verbosity, and more recent articles within the field use instead the phrase "intrapartum-related neonatal deaths" [65].

Definition of variables

Ethnicity

Ethnicity is a complex term, and it has been argued both as being based on biologically-given criteria [136] and as a socially constructed entity [137]. In the studies presented in this thesis, Brass' socially constructed definition of ethnicity was used [137], assigning ethnic identity to mothers according to their own information. This definition assigns great weight to ethnicity as a marker of group identity, making the ethnic belonging more important to minority groups with increasing demands from a developing society.

Economy

An asset index was used in study II and IV to assess household economic status. It has been argued in the literature that the use of an asset index is a better way to measure economic capacity than to record income or expenditure [138-140]. Income has a buffering character, and tends to vary over time, while surplus is accumulated and used in times of shortage. Results would therefore become inconsistent if income was used as a measurement [140]. Expenditure is thought to have a more even distribution over time and is therefore sometimes used as an alternative to income. However, both of these money-metric measures indicate problems with recall, and are subject to under-reporting, which ultimately results in poor data quality [139]. The use of an asset index, on the other hand, has been shown to be a consistent and valid method, allowing for comparisons over time as well as across different settings [139].

When constructing an asset index, the chosen assets to be recorded need to be assigned a weight. This is most commonly done by the use of principal component analysis (PCA), as described by Filmer and Pritchett [138]. Expansion and developments to this method have been made, for example, Booysen at al used multiple correspondence analysis (MCA) [141] and Moser and Felton suggested a method referred to as polychoric PCA [142]. In this thesis, however, we have chosen to use the basic PCA due to its relative simplicity and comparability.

The cutoff between poor and non-poor – the so-called poverty line – is arbitrary (i.e. relative), and it can be argued that the poverty line should be set at a low level relating to governmental guidelines [140] or at a higher level to promote a better discrimination ability [139, 141]. In the data from NeoKIP, the poverty line was decided as the cutoff of the first quintile (20th percentile).

Education

The school system in Vietnam is divided into primary, secondary and tertiary schools before the university level, and school attendance is high (having 94 % primary school attendance) [34]. In a number of articles, the

division between high and low education level is set at the completion of primary school (i.e. 5 years of schooling) [143, 144], or sometimes is designated at the high end as 12 years of education [145]. The division depends in one aspect of the sample: if it is possible to form large enough groups for analysis. However, the division must also be reasonable in relation to what is being explored.

GIS and distance measurement

GIS coordinates for health facilities and respondents' homes were gathered and a simple straight-line distance analysis was made. As argued above, this must be considered as a proxy for "true" distance. Road distances were also measured manually in the ArcGIS program, with a factor of 1.4 relative to the straight-line distance. The road distances were therefore omitted in the analysis. This was also done considering the uncertainty of the measurement. Road distance assumes that all roads are equal, does not consider temporary obstacles or detours, etc. The next step to getting closer to the "true" distance would be instead to do a raster analysis. This, however, demands a lot of local knowledge and data gathering; but it would then be possible to calculate iso-chronal maps displaying the travel time to different health institutions.

Another geographical aspect that has been just briefly mentioned in the four studies is the high mobility in Quang Ninh. Located on the border to China, with the main transportation route passing by, the population is highly mobile. This, in connection to the tradition in Vietnam that the pregnant woman goes home to her parents' house some time before delivery, may be problematic for the distance analysis since coordinates were only gathered from the current living place and not the place where mothers were at the onset of labor. To what extent the place of origin differs from the true place of origin is therefore not possible to extract from the present material.

Conclusion

Who can save the unseen?

The neonatal period has long been neglected in global health, resulting in a persistent neonatal mortality despite considerable improvements of overall child survival in the recent decades [146]. Fatalism and misconceptions have stalled development, and the width of the problem has not been visible in international statistics. Neonatal mortality has not been an indicator, but has been included in the wider term of infant mortality. The causes of death in the neonatal period have been grouped as "neonatal causes", not further specified despite the range of interventions needed in different situations sometimes leading to death. The first study from Quang Ninh province presented in this thesis revealed the invisibility of neonatal mortality in official statistics. Reasons for this under-reporting were diverse, but a common trait was the low importance the issue received at all levels: families were told to forget and go on with their lives and that it is unavoidable that newborns die and health staff members were afraid to be accused of maltreatment or poor achievement and therefore omitted reporting neonatal deaths. The consequences of this under-reporting are severe. Investment into the problem might be scarce because it has not been openly acknowledged.

It is not only in the registers and statistics that neonatal mortality is invisible. It is also a matter of marginalization and hierarchical structures. In a patriarchic society where sons are regarded higher than daughters, women's health is not a priority. This leads to gender inequalities in health [147]. Childbirth and the postnatal period fall into the category of gender inequity, resulting in an association between the social position of women in society and child health and survival [148]. In the same way, the poor, the less well-educated, and the ethnic minorities are discriminated against and marginalized, with inequities in health as the result. The Vietnamese government has put considerable emphasis on reducing economic disparities over the years, and has seemingly managed well. However, at the time of data collection, there remained a large inequity based on ethnicity which is reflected in the material presented in this thesis. The causes of such inequity are complex, involving higher home delivery rates and less ANC attendance among ethnic minorities. Many home deliveries are unknown to health care officials, and skilled attendance at birth can therefore not be promoted or

provided. Study results showed that a quarter of neonatal death cases did not have any contact with the health system at the time of death. But the sources of ethnic inequity can also be found among the attitudes and level of discrimination within the health system, causing difficulties in communication and a reluctance to seek care. In a rapidly changing society like Vietnam, a steep economic development causes the gaps between different segments to widen. Therefore, it is even more important to identify and acknowledge groups at highest risk – here found to be ethnic minorities – and to target them with interventions for improved neonatal survival.

Summary in Swedish/Sammanfattning på svenska

De osynliga dödsfallen – studier av neonatal dödlighet i Quang Ninh-provinsen, Vietnam

Varje år dör nära fyra miljoner barn under den första levnadsmånaden, de allra flesta redan under de första dygnen. En stor del av dessa dödsfall som sker i den s.k. neonatala perioden, d.v.s. under de första fyra veckorna efter födelsen, skulle kunna förhindras med enkla och kostnadseffektiva metoder. Trots detta har den neonatala dödligheten varit i det närmaste oförändrad de senaste decennierna. Den här avhandlingen avser att öka kunskapen om vissa orsaker till denna stagnerade utveckling. De fyra delarbetena har framtagits inom ramen för en större interventionsstudie för förbättrad neonatal överlevnad i Quang Ninh-provinsen i norra Vietnam, kallad NeoKIP (Neonatal health – Knowledge Into Practice).

Neonatal dödlighet har tidigare inte varit en indikator i internationell statistik utan varit inkluderat i spädbarnsdöd, d.v.s. alla dödsfall under det första levnadsåret. I dödsorsaksrapportering har dock "neonatala orsaker" använts, utan närmare specifikation. Detta vittnar om hur de neonatala dödsfallen osynliggjorts i statistiken, vilket försvårat riktade interventioner. Att känna till omfattningen och orsakerna till ett problem är det första steget till förbättring. Den första delstudien i denna avhandling har därför undersökt riktigheten i den officiella statistiken när det gäller neonatala dödsfall i Quang Ninh-provinsen. Genom en noggrann genomgång av register och rapportering på alla vårdinrättningar med perinatal vård i provinsen samt genom gruppintervjuer med en stor del (92.7 %) av alla byhälsovårdare registrerades neonatala dödsfall som skett under 2005. Dessa dödsfall jämfördes sedan med den officiella statistiken. Resultatet visade att endast vart fjärde barn som dog under de första fyra veckorna efter förlossningen rapporterades till den centrala statistik som också skickades vidare till hälsoministeriet och världshälsoorganisationen (WHO). Orsakerna till denna grava underrapportering fanns att finna både inom och utom hälsosystemet. Ansvarsfördelningen för rapporteringen av födslar och dödsfall var oklar, med flera olika institutioner inblandade. Mycket ansvar låg dock på

familjerna själva att registrera födslar och dödsfall på den lokala vårdcentralen och till folkbokföringen. Då de flesta neonatala dödsfall sker redan under det första dygnet hinner det nyfödda barnet inte registreras som fött innan det dör och risken att det hamnar utanför statistiken ökar då. Vidare var förståelsen för statistikens betydelse dålig bland hälsopersonalen och tillsammans med den rådande kulturen där det är viktigt att presentera goda resultat, av rädsla för reprimander eller med hopp om belöningar, gömdes många dödsfall i rapporteringen. Konsekvenserna av denna underrapportering är långtgående. Problemet osynliggörs och riktade insatser för att förbättra en till synes god neonatal överlevnad nedprioriteras eller omöjliggörs.

I stort sett alla neonatala dödsfall (99 %) sker i medel- och låginkomstländer. Denna ojämlikhet är i första hand inte en fråga om tillgång på resurser utan fördelningen av desamma. Kostnaden för att rädda upp emot två tredjedelar av de närmare fyra miljoner barn som dör varje år tidigt i livet har beräknats till ca 1 dollar per barn och år, vilket jämfört med andra hälsoinsatser är mycket lågt. En orsak till att detta inte sker är bristande statistik, vilket redan behandlats. I det andra delarbetet i denna avhandling har ytterligare riskfaktorer för neonatal dödlighet undersökts genom intervjuer med mammor i Quang Ninh-provinsen. Alla födslar och neonatala dödsfall under perioden juni 2008 till december 2009 registrerades, och mammorna till slumpmässigt utvalda nyfödda och mammorna till barn som dött i den neonatala perioden intervjuades två månader efter förlossningen. När man undersöker riskfaktorer är det viktigt att skilja på strukturella faktorer såsom utbildning och ekonomi och de mer närliggande bidragande orsakerna, s.k. proximala determinanter, t.ex ålder, civilstånd m.m. Utbildningsnivå eller ekonomisk ställning kan leda till ett visst beteende eller bemötande som i sin tur har inverkan på hälsan. Utbildning är i sig självt ingen direkt orsak till ohälsa utan effekterna av utbildning verkar genom de proximala determinanterna. I delstudie två i den här avhandlingen inkluderades tre strukturella riskfaktorer, utbildning, ekonomi och etnicitet. Resultatet visade att barn till mödrar med låg utbildning och mödrar som tillhör en etnisk minoritet har en markerat ökad risk att dö i den neonatala perioden. Att mödrar med låg utbildning är en utsatt grupp är väl känt sedan tidigare, men resultaten från delstudie två visade att nyfödda till mammor från en etnisk minoritet har störst risk att dö i den neonatala perioden, en riskökning som var oberoende av utbildning eller ekonomisk ställning. Vidare fanns i resultaten ingen riskökning för neonatal död baserad på ekonomiska förhållanden, vilket kan betraktas som anmärkningsvärt givet tidigare studier inom området. Ett antal proximala determinanter undersöktes också i delstudie två och där visade sig hälsoutnyttjandet före och vid förlossningen vara de faktorer som inverkade på överlevnadschanserna. Barn till mödrar som inte nyttjat mödravård och som förlöste hemma hade en två till tre

gånger så stor risk att dö den första månaden efter födelsen. En stor del av den bristande mödravården och hemförlossningarna återfanns inom de etniska minoritetsgrupperna och bland mammor med låg utbildning och kunde till en viss del förklara den tidigare riskökningen för dessa grupper. Men resultaten visade också att även om minoritetsmödrar gick till mödravården och/eller förlöstes inom hälsosystemet så bestod en markant riskökning för neonatal död i denna grupp.

Hälsoutnyttjande före och vid förlossningen har således stor betydelse för de nyföddas överlevnad. I delstudie tre och fyra undersöktes därför dessa aspekter närmare. Data från 2005 insamlade under NeoKIPs baslinjestudie analyserades med avseende på vårdsökande i delarbete tre. Resultatet visade att en fjärdedel av alla neonatala dödsfall under året hade skett utanför hälsosystemet och att andelen som dog kort tid efter förlossningen varierade med den vårdnivå mödrarna först sökt vård vid då det var dags att föda. Störst chans att överleva det första dygnet hade barn vars mödrar i först hand valt att föda på sjukhus. I det fjärde delarbetet användes geografiska analysmetoder för att undersöka betydelsen av avståndet mellan hem och vårdinrättning. Data från tidigare nämnda intervjuer analyserades och visade att vårdutnyttjandet i den perinatala perioden sjönk med ökande avstånd till en hälsoinstitution. Mödrar som bodde längst bort från en hälsostation eller ett sjukhus löpte också större risk att förlora ett barn i den neonatala perioden oavsett vårdutnyttjande, vilket betyder att avståndet i sig har betydelse och måste tas i beaktande när interventioner för förbättrad neonatal överlevnad planeras.

Att nära fyra miljoner barn dör varje år under den första levnadsmånaden är ett av världens dåliga samveten. Denna avhandling belyser några orsaker till detta missförhållande och pekar på de riskfaktorer som måste angripas. Problemet med den neonatala dödligheten har under de senaste åren fått en ökande uppmärksamhet men är till stora delar fortfarande ett osynligt problem. Den officiella statistiken runt den neonatala perioden är behäftad med osäkerhet och det är de mest marginaliserade, etniska minoriteter och lågutbildade, som löper störst risk att drabbas. Framtida interventioner för förbättrad neonatal överlevnad bör därför riktas mot dessa grupper.

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