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Mortality in transitional Vietnam

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ABSTRACT

Understanding mortality patterns is an essential pre-requisite for guiding public health action and for supporting development of evidence-based policy. However, such information is not sufficiently available in Vietnam. Mortality statistics and causes of death are solely collected from health facilities while most deaths occur at home without the presence of health professionals. Facility-based data cannot represent what happened in the wider community. This thesis studies the patterns and burdens of mortality as well as their relationships with socio-economic status in rural Vietnam. The overall aim is to contribute to the improvement of the current system of mortality data collection in the country for the purposes of public health planning and priority setting.

The study was carried out within the framework of an ongoing Demographic Surveillance System (DSS) in Bavi district, Hatay province, northern rural Vietnam. This study used a verbal autopsy (VA) approach to identify cause of death in a cohort of approximately 250,000 person- years over a five-year period from 1999 to 2003.

During the five year study, a total of 1,240 deaths were recorded and VA was successfully completed for 1,220 cases. Results revealed that VA was an appropriate and useful method for ascertaining cause of death in this rural Vietnamese community where specific data were otherwise scarce. The mortality pattern reflected a transitional pattern of disease in which the leading cause of death was cardiovascular diseases (CVD), followed by neoplasms, infectious and parasitic diseases, and external causes, accounting for 28.9%, 14.5%, 11.2%, and 9.8%, respectively. In terms of premature mortality, there were 85 and 55 Years of Life Lost (YLL) per 1,000 population for males and females respectively. The largest contributions to YLL were CVDs, malignant neoplasms, unintentional injuries, and perinatal and neonatal causes. In general, men had higher mortality rates than women for all mortality categories. In adults of 20 years and above, mortality rates increased substantially with age, and showed similar age effects for all mortality categories with the strongest association for non-communicable diseases (NCD). Education was an important factor for survival in general, and high economic status seemed to benefit men more than women. Compared with cancer and other NCD causes, higher CVD rates were observed among males, the elderly, and those without formal education, using a Cox proportional hazards model.

This study is an initial effort to provide information on mortality patterns in a community using longitudinal follow-up of a dynamic cohort. Continuing the study using the VA approach as part of routine data collection in the setting will help to show trends in mortality patterns for the community over time, which may be useful for priority setting and health planning purposes, not only locally but also at the national level. Further analyses are needed to understand mortality inequality across all ages to have a comprehensive picture of mortality burdens in the setting. Validation studies and further standardization of VA methods should be carried out whenever possible to improve the performance and extension of the technique.

Key words: *Cause of death, verbal autopsy, mortality, rural Vietnam*

ABBREVIATIONS

CHS	Commune Health Station
CI	Confidence Interval
CoD	Cause of Death
CVD	Cardiovascular Disease
DALY	Disability Adjusted Life Year
DHS	Demographic and Health Survey
DSS	Demographic Surveillance System
FilaBavi	Epidemiological Field Laboratory in Bavi District
GBD	Global Burden of Disease
HIV	Human Immunodeficiency Virus
HR	Hazard Rate
ICD	International statistical Classification of Diseases and related health problems
IMR	Infant Mortality Rate
INDEPTH	International Network of field sites for continuous Demographic Evaluation of Populations and Their Health in developing countries
MOH	Ministry of Health
NCD	Non-communicable disease
OR	Odds Ratio
PPP	Purchasing Power Parity
SAREC	Swedish Agency for Research Co-operation with developing countries
SES	Socio-Economic Status
Sida	Swedish International Development Agency
SVR	Sample Vital Registration
TB	Tuberculosis
U5MR	Under-Five Mortality Rate
UNDP	United Nations Development Programmes
USD	US Dollars
VA	Verbal Autopsy
VND	Vietnamese dong (1 US$ = 15,900 VND approximately)
WHO	World Health Organization
YLD	Years of Life with Disability
YLL	Years of Life Lost
YPLL	Years of Potential Life Lost

ORIGINAL PAPERS

The thesis is mainly based on the following papers

I. **Huong DL**, Minh HV, Byass P. Applying verbal autopsy to determine cause of death in rural Vietnam. Scand J Public Health. 2003; 31 (Suppl 62):19-25.

II. **Huong DL**, Minh HV, Vos T, Janlert U, Van DD, Byass P. Burden of premature mortality in rural Vietnam, from 1999-2003: analyses from a Demographic Surveillance Site. Popul Health Metr. 2006, 4:9, doi:10.1186/1478-7954-4-9

III. **Huong DL**, Minh HV, Janlert U, Van DD, Byass P. Socioeconomic status inequality and major causes of death in adults: a 5-year follow-up study in rural Vietnam. Public Health. 2006;120(6): 497-504.

IV. Minh HV, **Huong DL**, Wall S, Chuc NTK, Byass P. Cardiovascular disease mortality and its association with socio-economic status: findings from a population-based cohort study in rural Vietnam, 1999-2003. Prev Chronic Dis. 2006 Jul; 3(3):A89. Epub 2006.

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The papers will be referred to by their Roman numerals I – IV

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CHAPTER I: INTRODUCTION

1.1. The importance of mortality data in public health systems

Mortality data represent essential elements for the quantification of health problems. It is one of the most important health indicators for measuring a country's health development. Information on cause-specific mortality is crucial for summarizing the total burden of disease in different settings. Understanding mortality patterns is very useful, and is considered to be an essential pre-requisite for guiding public health action and for supporting development of evidence-based policy. Commonly, mortality statistics are used to [1]: (a) establish the public health importance of different causes of death; (b) help in identifying priorities and appropriate interventions for avoidable causes of death; (c) study the trend in cause-specific mortality over time, which is especially valuable in a longitudinal surveillance system; (d) make comparisons of cause-specific mortality between groups (regions, countries) or between individuals (by gender, age group, etc); and (e) evaluate the effect of interventions on cause-specific mortality. Moreover, it has also been suggested that mortality can be measured more easily than morbidity (sickness). The assumption is that morbidity changes in parallel with mortality, even if not at the same rate, although this may not always be true, especially for older people [2, 3].

Mortality data have also received special attention by policy makers. Mortality measures are expressed in two targets of the Millennium Development Goals and in one out of three components of the Human Development Index [4]. In 2006, the World Health Organization (WHO) showed its interest in mortality information by issuing a special WHO Bulletin theme issue on mortality surveillance, confirming that "counting the dead is essential for health" [5]. This issue focused on the importance of mortality data in measuring health status of people all around the world as well as different efforts in collecting data and making effective use of them for policy makers.

1.2. The change in mortality patterns during epidemiological transition

The epidemiological transition theory was conceived by Omran in early 1970s [6]. It encompasses changing patterns of disease and health (health transition), changing fertility and

population age structures (parts of demographic transition), changing lifestyles, changing health care patterns, medical and technological evolutions (technological transition), and environmental and ecological changes (ecological transition). In his work, Omran originally defined three stages of epidemiological transition: 1 - the "age of pestilence and famine", 2 - the "age of receding pandemics", 3 - the "age of degenerative and manmade disease" [6]. Thirty years later, Omran proposed two more stages for the western model: 4 - the "age of delayed degenerative diseases" and 5- the "age of aspired quality of life, with paradoxical longevity and persistent inequities" [7]. Some other authors also suggested a new fifth stage of the epidemiological transition – the re-emergence of infectious and parasitic diseases stage, which had happened in some population subgroups [8].

Within the complex dynamics of epidemiological transition, mortality is a most fundamental force exerting its influence through rises in pre-modern societies or through declines in modern times. The pattern of mortality changes over the different stages of epidemiological transition, from predominant infectious diseases, malnutrition and maternal complications in stage 1 and 2, to increasing cases from cardiovascular disease (CVD), cancer, and other man-made diseases in stage 3, and aging in stage 4 (Table 1). At some points in the process of transition, there may be a "double burden" of disease in which non-communicable diseases (NCD) increase while pre-existing infectious diseases still remain.

While the epidemiological transition progressed slowly over a century in the developed world, it appears to be moving faster in some developing countries. The epidemiological transitions in "non-western societies" occur with different acceleration, timing and magnitude of changes; thus they can be differentiated into rapid, intermediate and slow transition models. "Non-western societies" have experienced prolonged pestilence and famine (stage 1) as well as the stage of receding epidemics (stage 2). Omran later proposed a different third stage for non-western countries, "the age of triple health burden", i.e. the unfinished old set of health problems, a rising new set of health problems, and ill-prepared health systems to cope with the prevention and care of chronic diseases [7].

However, it is likely that non-western countries will not experience an age of declining cardiovascular mortality, aging, lifestyle modification, and emerging and resurgent diseases in the same way as has been experienced by western societies. In the future, it is possible that these countries may have mixed disease patterns and health care responses with even more significant inequities compared to the West [7].

Table 1. The four stages of epidemiological transition [6]

Stage	Degree of socio-economic development	Life Expectancy (years)	Broad disease categories	Change within broad disease categories (proportionate mortality)
1 - The age of pestilence and famine	+	about 30	High infections and nutritional deficiencies	Cardiovascular disease (CVD): 5-10% related to nutrition/ infection (e.g. Rheumatic heart disease (RHD), Chagas disease. Infectious diseases: 3/4 of deaths
2 - The age of receding pandemics	++ (developing countries)	30 - 50	Improved sanitation: ↓ infections, ↑ dietary risks (salt), ↑ aging	CVD: 10-35% hypertensive heart disease, stroke, sequels of RHD
3 - The age of degenerative and manmade disease	+++ (countries in transition)	50-55	↑ aging, ↑ lifestyles related to high socio-economic status (diet, physical activity, addiction)	CVD: 35 – 65%. Obesity, dyslipidemias, high blood pressure, smoking → Coronary heart disease, stroke, often at an early age; (first in ↑ socio-economic status)
4 - The age of delayed degenerative diseases	++++ (western countries)	about 70	↓ risk behaviours in the population (prevention and health promotion and ↑ new treatment)	CVD < 50% (delayed ↓ total CVD due to aging population & ↑ prevalence due to better treatment)

Note: *→ no change,↓ decrease, ↑ increase*

1.3. Certifying cause of death: an overview

By medical definition, death is defined as: "either (a) irreversible cessation of circulatory and respiratory functions, or (b) irreversible cessation of all functions of the entire brain, including the brain stem" [9]. In developed countries, every death is required by law to be registered by local authorities, and, in many places, this is a compulsory pre-requisite for funeral ceremonies [10]. In order to register a death, a medical certificate stating the cause of death is needed, from the doctor who attended the deceased during his/her last illness.

In the certificate, causes of death are certified at different levels (underlying, intermediate, and immediate causes of death), which are linked in a sequential cause-and-effect relationship when read from the bottom to the top of the certificate. Among them, the underlying cause of death has the greatest medical, legal, and epidemiological importance. If there is insufficient information available to accurately cite other causes, underlying cause of death is the only one required [11].

Historians of medicine have shown little interest in cause of death registration. In the past, and even today, the determination of cause of death is not seen as an important medical activity [12]. Physicians are primarily concerned with treating the diseases of the living; moreover, from a clinical point of view, they consider that causes of death are not always important causes of sickness and vice versa. The fatal infectious diseases of the past often left little opportunity for medical intervention, while some less serious diseases and chronic conditions cause a great deal of sickness but few deaths. However, cause of death registration has grown out of the desire of national and municipal officials to monitor threats to public health since the middle of the eighteenth century. Cause of death data were used to control the environmental sources of disease and to draw attention to infectious diseases. Death registration was often a response to public fears of epidemics, and early registration systems sometimes targeted epidemic disease for special attention. It should be noted that causes of death from communicable diseases, especially epidemic diseases with distinctive symptoms, were much better observed and recorded than those from non-communicable and degenerative diseases [12].

In public health, certifying cause of death has played a very important role. The model of epidemiological transition by Omran, which argued for changing the cause of death structure, was based on historical cause of death registration and certification. Sweden, one of very few countries having an official mortality statistics system since the 18th century, can provide valuable evidence on the community health situation and disease pattern change over time, even though care is needed in considering the competence and ambitions of those who reported diagnoses during these early centuries [13]. Cause of death certification, which

normally done by trained physicians, is always believed by authorities to be more accurate and consistent than lay registration, but physicians have sometimes been reluctant to participate [14]. Hence there is an urgent need for more proactive strategies for training doctors about the public health importance of mortality data and how to accurately certify causes of death in effective ways for disease prevention and health planning [15].

1.4. Verbal autopsy (VA): an alternative method for determining cause of death

Historically, cause of death (CoD) has been determined either by autopsy or by attending physicians. Clinical autopsies serve two major purposes: to gain more insight into pathological processes and to determine what factors contributed to a patient's death. Autopsies can yield insights into how similar patient deaths can be prevented in the future. Nowadays however, autopsies are only usually performed in cases of sudden death, where an attending doctor is not able to write a death certificate, or when death is believed to be due to an unnatural cause [16].

In developed countries, almost all deaths have medical diagnoses for CoD by attending physicians, as required for funeral procedures, but this is not the case in developing countries, where most deaths occur at home without the presence of medical professionals. In many of these countries, death certificates with physician diagnoses is not required for funeral procedures, and hence CoD information is often unavailable either at the individual or community level.

In this situation, VA is an alternative method for ascertaining CoD. The method uses information obtained from close relatives or caretakers of a deceased person about the circumstances, signs and symptoms during the terminal illness in order to assign the most probable CoD [17]. It is based on the assumption that most CoDs can be distinguished by their signs and symptoms and that these can be accurately recognised, recalled and reported by lay respondents [18].

Verbal autopsy methods was first created in the 1950s and 60s in Asia (Khanna and Narragwal in India, Companiganj in Bangladesh) and in Africa (Keneba in The Gambia), which used systematic interviews by well-trained physicians to assess CoD [19]. However, in-depth interviews by physician are costly and may involve biases towards a particular diagnosis during the interview. Questionnaire-based VAs were then developed, which appeared to be advantageous for epidemiological research. They allow all available information to be recorded objectively for later deriving likely CoDs. The VA method was widely introduced in the mid 1970s when the WHO suggested "lay reporting" of information about health issues by people with no medical background. WHO published a guide "dead record", which seemed to be the first formal VA questionnaire [20]. Because VA is based on interviews after deaths, it does not require observations by health workers on live patients. Since then, VA has become a widely used technique for assessing causes of childhood death in several settings. The application of VA to assess causes of adult deaths has been extended globally in recent years and become a routine technique. In general terms, VA has become an important method for ascertaining CoDs in settings with poor data on mortality, weak vital registration systems and low proportions of deaths occurring under medical care across all ages.

1.5. Collecting mortality data: the current situation in developing countries

In many developing countries, where most deaths occur at home without the presence of medical professionals, certification and registration of CoD are still scarce. Only a third of global deaths are registered, including information on age, sex, and cause of death, and the vast majority of unregistered deaths occur in developing countries [21]. The coverage of death registration varies among countries, from nearly 100% in the WHO European Region to less than 10% in the African Region [22]. In rural Africa, more than 80% of childhood deaths occur at home and are not registered in any routine mortality reporting system [23]. The situation on adult death registration is even worse. Data on levels and causes of adult deaths in developing countries are much weaker than information for childhood deaths [24]. Information quality is also a big concern. Among 115 member countries of the WHO reviewed, only 23 countries, mostly in Europe and North America, have mortality data that are more than 90% complete (defined as ill-defined causes accounting for less than 10% of

total deaths, and where International Classification of Diseases version 9 (ICD-9) or ICD-10 codes are employed) [22]. There have been a lot of efforts to improve mortality information internationally and nationally. Different options for mortality data collection have been adopted according to resources and capacity at country level, such as routine vital data registration, passive facility-based systems, censuses, Demographic and Health Surveys (DHS), Sample Vital Registration (SVR), and Demographic Surveillance Systems (DSS). All of these are necessary and complementary elements of a comprehensive international and national health information systems, defined as follows:

- *Routine Vital Registration (VR):* the registration and documentation of vital events by civil authorities. The purposes of the system are to meet legal requirements to establish civil status and protect individual rights, and, for public health, it should serve as a source of data for informing policy and planning. However, data are always under-reported. It was noted that only about one third of the 56 million deaths estimated to occur annually in the world are recorded by VR systems [22].

- *Routine facility-based information systems:* the main source of health statistics in many developing countries, but merely based on the available structures of the health system itself. This system is an unreliable data source for estimating disease burden in the population since the statistics generated are biased towards those who actually use public health facilities, and who have better accessibility in geographical and socio-economic terms [25]. This system tends to miss deaths that occur at home, which also tend to have different CoD patterns from those occurring in health facilities. It is noted that in low income, and even some middle-income countries, these may constitute the majority of all deaths in the population, and ascertainment is likely to be much worse in poorer communities.

- *Censuses:* surveys periodically carried out, for example at a basic interval of five or ten years. They are an important source of data for measuring mortality since they cover entire populations and can generate indirect estimates of mortality levels. Unfortunately, census data have historically been of inadequate quality and collected with insufficient frequency to permit the analysis of child mortality, and the application of modules to measure adult mortality has not been a priority and cannot be used to ascertain CoD [26]. Because of

long intervals, even if mortality measurement in censuses were improved, that would still be of limited use for most policy purposes or for planning, monitoring and evaluation.

- *Demographic and Health Surveys (DHS):* many countries apply nationally representative surveys to measure key health indicators by geography, ethnicity, and socio-economic status. However, these surveys have certain limitations in measuring mortality because sample sizes for surveys have not been designed specifically to detect mortality, and are hence too small to calculate mortality by different strata [27].

- *Sample Vital Registration (SVR):* defined as a community-based system implemented in a nationally representative sample with functions for continuous enumeration of births, deaths and migrations; to determine probable CoDs; and periodic independent enumeration of populations and vital events to verify resident populations and assess completeness of registration. This system has been identified as leading towards universal vital registration [25]. China and India, the two most populated developing countries, have currently employed the system for collecting mortality information in a 1% representative sample of their population [28]. Some other countries in Africa and Asia have begun to plan for their own systems. However, issues like capacity and funding for maintaining such a large coverage sample are major obstacles for its expansion and popularity.

- *Demographic Surveillance Systems (DSS):* on a smaller scale than SVR, DSS have been developed in many developing countries in Africa, Asia and Latin America in recent years. These field sites have formed a network called INDEPTH, which stands for an International Network of field sites with continuous Demographic Evaluation of Populations and Their Health in developing countries (www.indepth-network.net) with 36 member sites in 18 countries. DSS functions are to define risk and corresponding dynamics in rates of births, deaths, including CoD, and migration in a population over time. They are often set up for specific intervention studies and later convert into long-standing DSS sites that can then be platforms for further studies [29]. They are generally operate in defined areas with modest populations under surveillance (e.g. 30,000 inhabitants), which however can affect their representativeness [25].

Among the above systems for collecting health data, SVR and DSS are specific systems for getting mortality information on both numbers and causes of death using verbal autopsy methods. They are good options for countries with weak vital registration systems to get updated and reliable data on population health for health management and monitoring purposes.

1.6. Quantifying burdens of premature mortality

Since mortality rates are fundamental measures of community health, quantifying burdens of mortality have received attention from health workers. Crude and specific mortality rates can describe the extent of deaths in a population, but they cannot quantify the burden of life years loss resulting from this mortality [30]. In public health, preventing premature death is an important goal, so the indices focusing on social and economic loss resulting from a death before its "natural" time, rather than merely the occurrence of death itself, are attractive.

The Years of Potential Life Lost (YPLL) was formally introduced by the Centers for Disease Control (CDC) in 1982 as a basis for calculating monthly statistical tables that ranked the leading causes of premature mortality in the United States [31]. However, the methods had been proposed by Dempse [32] and then Greville [33] in late 1940s. This index was considered to be "simple to compute and comprehend and it effectively emphasises deaths of younger persons, in contrast to usual mortality statistics, which are dominated by deaths of the elderly" [31]. There were several alternatives to YPLL measures applied in different studies, which were summarised by Gardner [30]. In principle, YPLL estimates the average time a person would have lived if she or he had not died prematurely. The definition of premature death or the identification of an upper age limit is a persistent controversy in the calculation of YPLL. The age cut-off point of 65 years was used by the Center for Disease Control (CDC) [31] and others [34, 35], but 70 years by O'Shea [36] and Arnold [37], and 75 years by the Canadian Statistical Office [38] and some other studies [39, 40]. Debates were around the age at which death from more natural causes could not be distinguished from premature and preventable causes [10, 31], or whether death after 70 years might be diagnosed inaccurately [41, 42], or age wrongly related to time of retirement or when job productivity ended. Other

concerns and debates about YPLL measures are that they ignore deaths of people above selected upper age limits in the calculations and putting different values on the years of life lost in various periods of life [30].

In recent years, another more preferable method of quantifying burdens of premature mortality has been used widely in the global context. This method was initially introduced in a comprehensive assessment of disease burden in 1992 by the World Bank Commission in the Global Burden of Disease study (GBD) [43-45]. To assess burden of disease, the 1990 GBD study used a time-based metric that measured both premature mortality (years of life lost because of premature mortality or YLL) and disability (years of healthy life lost as a result of disability or YLD, weighted by the severity of the disability). The sum of the two components, namely Disability Adjusted Life Years (DALYs), provides a measure of the future stream of healthy life (years expected to be lived in full health) lost as a result of the incidence of specific diseases and injuries. Much of the comment on, and criticism of, the GBD study focused on the construction of DALYs [46-48], particularly the social choices pertaining to age weights and severity scores for disabilities. However, one component of DALYs, YLLs, have been used independently in many studies to quantify the burden of premature mortality in different settings [49-52]. YLL calculations cover deaths across all ages, and assuming that deaths at the same age contribute equally to the burden of disease. The highest life expectancy was chosen at 82.5 years as of women in Japan (and for men was 80 years as the male-female "biological" difference in survival potential was chosen as 2.5 years), and the standard expectations are therefore based on a model life table, namely Coale and Demeny West level 26 [53]. DALY measures by specific CoD and major risk factors have been estimated for all WHO country member states and regions for 1990 and 2002 and projected for 2015 in the recent Global Burden of Disease Study and become important and formal reference data sources [54].

1.7. Vietnam

General information

Vietnam is a long, S-shaped country with an area of 331,000 km^2. The distance from the north to the south is about 3,000 km. It is located in south-east Asia, bordered by China on the north, Laos and Cambodia on the west, the Gulf of Thailand and South China Sea on the south, and the Gulf of Tonkin on the east. The geography of the country consists of three parts: delta, midland, and highland. There are two main delta areas, the Red River Delta in the north and the Mekong Delta River in the south. Eighty percent of the country is covered by mountains, high plateaux and jungles. The climate varies between regions, with a tropical climate in the south and a sub-tropical climate in the north. The northern part experiences four seasons (spring, summer, autumn and winter), the south has only two (dry and wet). Vietnam also faces typhoons and floods every year, occurring from June to October.

The population of Vietnam was estimated at 83 million inhabitants in 2005. It has an annual population growth rate of 1.32%, and a fertility rate of 1.94 children born per woman. The average population density is about 230 persons per square kilometre. It is estimated that 51.5% of the population are women and 48.5% are men. The Vietnamese population structure is young, as in other developing countries, the population under 15 years of age being nearly 27.9% while only 5.8% the population is over 65 years of age (1999 National Census). Eighty percent of the population of Vietnam live in rural areas. The main ethnic group is Kinh, comprising 86% of the population. There are about 50 other ethnic groups in the country mainly living in remote areas in the north, northwest, and central provinces.

Vietnam's literacy rate is relatively high compared with other developing countries that have similar GDP per capita. Eighty-eight percent of the population aged 10 years and over can read and write. The main economic resource of the country is agriculture, the main occupation for nearly 70% of the population. In 1986, the Vietnamese government initiated a wide-ranging economic reform programme known as "*Doi moi*" (politics of renovation). The programme put Vietnam firmly on the path to transforming itself from a planned economy to a market economy. During "*Doi moi*", Vietnam has made progress in improving economic

conditions, educational levels and the health status of the population. In general, in urban as well as rural areas, people's livelihood has improved; the number of poor households (income insufficient to provide meals of 2,100 calories/person/day) fell from 58 to 29 percent between 1993 and 2002. During the period from 1990 to 1996, GNP per capita increased from 215 to 290 USD and GDP growth rate increased from 5% to 9%. This spectacular success results from the combination of sound market economic management, increased reliance on market mechanisms, strong emphasis on the delivery of social services, and sustained improvements in infrastructure.

Health care system

The health care services in Vietnam are structured in three levels. The Ministry of Health (MOH) has the overall management of the system. It is the main national authority in the health sector for formulating and executing health policy and programmes in the country. The Ministry manages the manufacture and distribution of pharmaceuticals, and is also involved in training physician, coordinating medical research, setting prices in private health facilities, and is ultimately responsible for the provision of all preventive and a large part of the curative health services in the country.

The second level is provincial with 64 Provincial Health Bureaux. Although under the professional management of the MOH, the Bureaux are also located within provincial local governments under the Provincial People's Committees (PPC). In each province, there is at least one general hospital with 200-1,000 beds and some specialised centres or hospitals.

The basic level of health care includes district health centres, commune health stations, and the village health worker (VHW) network. There is one general hospital in each district, which serves as a referral service for all inter-communal polyclinics and commune health stations (CHS) in the district. The CHS has responsibility for providing primary health care, including preventive, ambulatory and inpatient services for the commune population, which varies from 5,000 to 10,000 people. It is expected to implement national health programmes, such as Maternal and Child Health and Family Planning, Extended

Programme of Immunization (EPI), Control of Diarrhoea and Dehydration (CDD), and Prevention Programme on Acute Respiratory Infections. The VHW network, which covers about 90% of villages in Vietnam, provides basic and emergency health care services at the community level.

Table 2. The Public Health Care System in Vietnam

Administrative Authority	Health Authority	Main health facilities
Central Government	Ministry of Health	- Departments in the MOH - National medicine/pharmacy training colleges - Central hospitals - Central research/professional institutions - Central pharmaceutical companies/factories
Provincial People's Committee	Provincial Health Bureau	- Provincial health bureaux - Provincial hospitals - Provincial preventive health centres - Provincial pharmaceutical companies/factories
District People's Committee	District Health Centre	- District health centres - District hospital/policlinics - District preventive health teams - Public pharmacies
Commune People's Committee	Commune Health Station	- Commune health stations - Drug outlets - Village health workers

***Source**: Ministry of Health of Vietnam, 2000*

Transition in the Vietnam health sector

Along with all aspect of the economy, Vietnam's health care system is in the midst of a dramatic transformation. Important policies for health sector reformation included the legalization of private health sector, the introduction of user fees, and health insurance in 1989. All of these tools focus on the financing for health, as important replacements for the previous government fully subsidised mechanism, which lasted until the mid 1980s. As a result, out of a Purchasing Power Parity (PPP) index of US$ 134 (an index that attempts to measure the "real" purchasing power of nominal incomes across countries) spending for

health care per capita, only about one quarter of spending is estimated to come from the public sector, with the rest coming from out-of-pocket expenditure. Across categories of general government spending, Vietnam allocated only about 6% to health care, with less than 1% of GDP spent on current health service, which is low in comparison with other countries in the region and countries with similar levels of income [55].

As the consequence of the high proportion out-of-pocket payments for health care, the poor have less opportunity to get good health care compared with the better-off. Inequity in health care and proportions of health spending between different social and economic groups has been raised as a current challenge for the health sector. Substantial disparities in health status indicators are obvious by region, income, and ethnicity. In 2002, a four-fold range in infant mortality rates was observed between the northern mountains (40.9 deaths per thousand) and the southeast (11.3 deaths per thousand), as well as between those whose mothers had no education compared with those who had completed secondary school (58.6 vs 13.2 deaths per thousand population, respectively) [56].

To deal with these problems, the Government's strategy for the health sector is necessarily turning towards the introduction of health insurance and the public funding of health care expenses for the poor. In particular, Decision 139/2002 has strengthened earlier targeted interventions by creating provincial Health Care Funds for the Poor, which could cover 11 million beneficiaries, representing about 84% of the target group. Other policies towards improving health care for vulnerable groups were also promulgated, such as free health care for children under 6 and elderly over 90 years old.

Health status in transitional Vietnam

Even though it has been among the poorest countries in the world, Vietnam has been an "over-achiever" with regards to the health status of its people compared to its economic development. During the past few decades, Vietnam has made great progress in improving people's health status (Table 3). The incidence of communicable diseases has fallen in recent decades, represented in decreased shares of total morbidity and mortality from 55.5% and

53.0% in 1976 to 27.4% and 17.4% in 2003. These facts reflect the success of communicable disease control programmes, especially the Expanded Program of Immunization (EPI), which has dramatically reduced the incidence of vaccine-preventable diseases in the country.

Table 3. Main health indicators for Vietnam in 2005 [57]

Total population (million)	83.5
Population growth rate (percent)	1.32
Infant mortality rate (per 1,000 live births)	18
Under five mortality rate (per 1,000 live births)	28.5
Maternal mortality ratio (per 100,000 live-births)	85
Birth weight < 2500g (percent)	5.8
Overall life expectancy (years)	73.1
Number of doctors per 10,000 inhabitants	5.65
Number of pharmacists per 10,000 inhabitants	0.76

Despite the decline in their incidence, communicable diseases continue to be major public health problems in the country. Acute respiratory infections, diarrhoea and gastroenteritis of presumed infectious origin, and parasitic diseases were among leading causes of morbidity in 2003, while new or re-emerging diseases, such as tuberculosis (TB), HIV/AIDS, dengue fever and Japanese encephalitis, are increasing. On average, there are more than 68,500 new TB patients every year. In 2003, 4.3% of TB patients were HIV-positive [55]. By the end of May 2005, there had been 95,871 cases of HIV infection detected, of which 15,618 cases had progressed to AIDS, and 8,975 people had died [58]. Severe Acute Respiratory Syndrome (SARS) was detected in its early stages in Vietnam in 2003 with five deaths out of 63 reported cases. The avian influenza H5N1 virus causing poultry outbreaks led to the death of 42 out of 93 reported cases of infected persons by May 2006 [55].

While Vietnam continues to struggle with communicable diseases, nutritional deprivation, and reproductive health risks among children and women, NCDs are becoming more prevalent and cause a heavy burden of morbidity and mortality. According to national hospital statistics, NCD admissions increased from 39 % in 1986 to 65% in 1997 and NCD deaths from rose from 42% in 1986 to 62% in 1997 [59]. In 1998, hospital data showed that CVD deaths became more common: stroke, acute myocardial infarction, hypertension and heart

failure were responsible for numbers one, four, five and seven among the leading causes of death, respectively [60]. In 2002, intracerebral haemorrhage, hypertension-related diseases, heart failure and malignant neoplasms were among the ten leading causes of morbidity and mortality in hospitals [56]. Figure 1 and Figure 2 belows show the trend of mortality and morbidity in hospitals in Vietnam for the period from 1976 to 2003 [61].

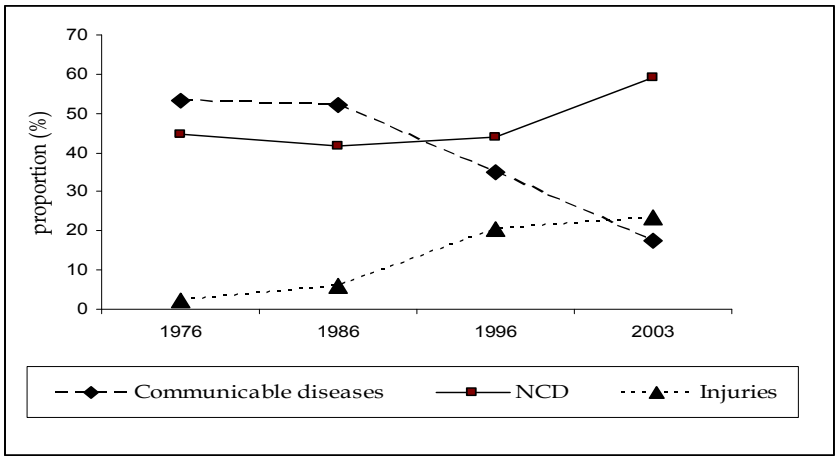


Figure 1 . Mortality patterns in hospitals in Vietnam 1976-2003

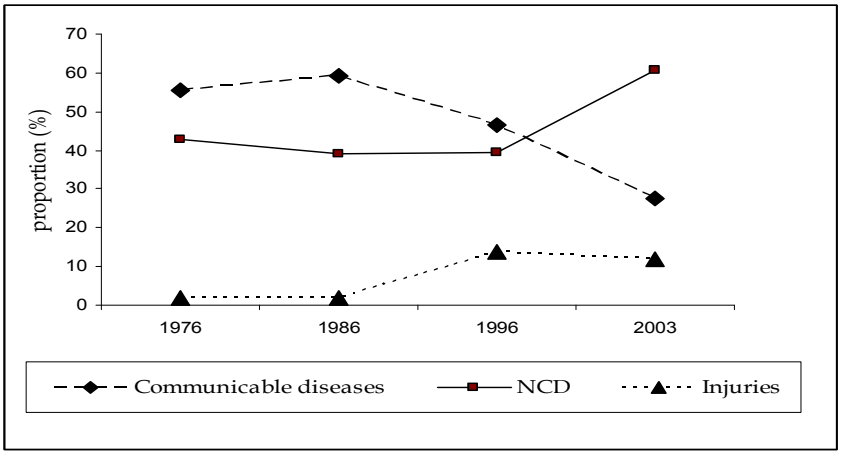


Figure 2 . Morbidity patterns in hospitals in Vietnam 1976-2003

Health information systems and current mortality reporting systems in Vietnam

In general, the focus of the health information system in Vietnam has been on collecting and transmitting data within the health services. Analysing data and making use of results has not been done systematically. Data are collected at all basic health institutions and are usually entered into standardised registers. Vertical national health programmes register their data in

commune health stations in a separate way. There is little information about past and present mortality in Vietnam, as the first official data on mortality have only become available from censuses taken in 1979 and subsequently every 10 years [62].

Recently, the MOH issued new regulations on health information and on the promulgation of health statistics records and reporting forms. Decisions were taken concerning the basic indicators to be used at the peripheral level (97 indicators) and at the district level (121 indicators) (Decision No 2553/2002-MOH and Decision No 379/2002-MOH). These decisions cover the system for primary record books for the basic health care network, and tables and models for reporting, in an attempt to unify and standardise the collection of data at the peripheral level. An informal evaluation by the WHO on the completeness of vital registration data in Vietnam indicated an under-reporting rate of around 10% for births and 20% for deaths [63]. Another study also showed an under-reporting rate of about 20% for all deaths of the routine registration system [64]. Major weaknesses of the Vietnamese health information system were pointed out in the WHO evaluation report, which identified under-reporting, too many parallel systems, lack of qualified personnel and inadequate monitoring and supervision [63].

In Vietnam, as ruled by Government Decree, the Ministry of Justice has a formal responsibility to issue certificates for vital events such as birth, death, and marriage. Death certificates, which do not include any medical cause, are issued at the request of a deceased's family, but are not compulsory for funeral or burial procedures. There are different systems collecting mortality data independently at commune level [1]. The first is commune population registers maintained by one person in each commune and controlled by the Population, Family and Children Committee. In principle, every death of anyone in the commune is entered onto this register. The second source of information on deaths is the registers in commune health stations, which are under the vertical supervision of the health sector. Every death notified in the commune is registered in the general health report. Not all these systems obtain the same data because of their different interests. While the Population, Family and Children Committee system is more interested in census data, with numbers of

births and deaths, the health system records both numbers and causes, but not precise medical CoDs, particularly for the majority of deaths which occur at home without the presence of any medical professionals.

Other data on deaths are obtained from hospitals, which have medical diagnoses only for deaths occurring at the health facility, which are few in number and cannot reflect CoD patterns in the whole community. Almost all deaths are not autopsied, apart from certain cases with legal implications. Up to now, hospital statistics have been considered as the main source of data on morbidity and mortality for the country, forming the basis for the Health Statistics Year Book produced annually by the MOH. Community-based data are largely lacking and cannot provide sufficient evidence for informing health policy-making and planning.

Farming in FilaBavi

1.8. Study objectives

Overall objective:

The overall objective is to study the mortality pattern in rural transitional Vietnam, and to contribute to the improvement of the current system of mortality data collection in the country for purpose of public health planning and priorities.

Specific objectives:

(a) To test the feasibility of using verbal autopsy method to determine cause of death in settings which lack sufficient representative mortality data (**I**).

(b) To describe the general pattern of mortality in the rural setting of Vietnam (**I, II**).

(c) To measure the burden of premature mortality by cause of death in the rural setting of Vietnam (**II**).

(d) To analyse associations between socio-economic factors and adult cause-specific mortality in the rural setting of Vietnam over a five-year period (**III, IV**).

1.9. Outline of publications

The outline of publications is shown in Figure 3.

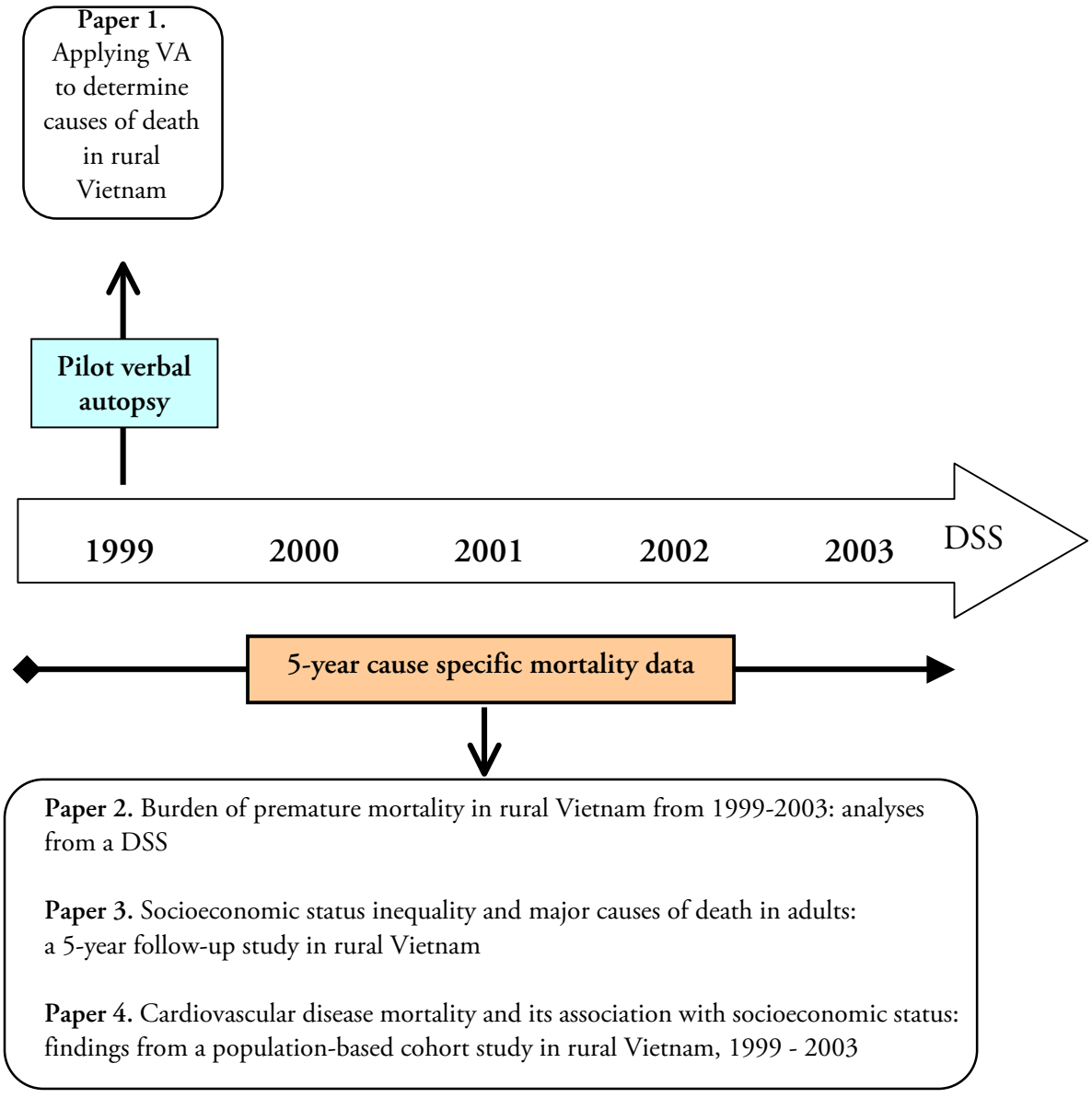


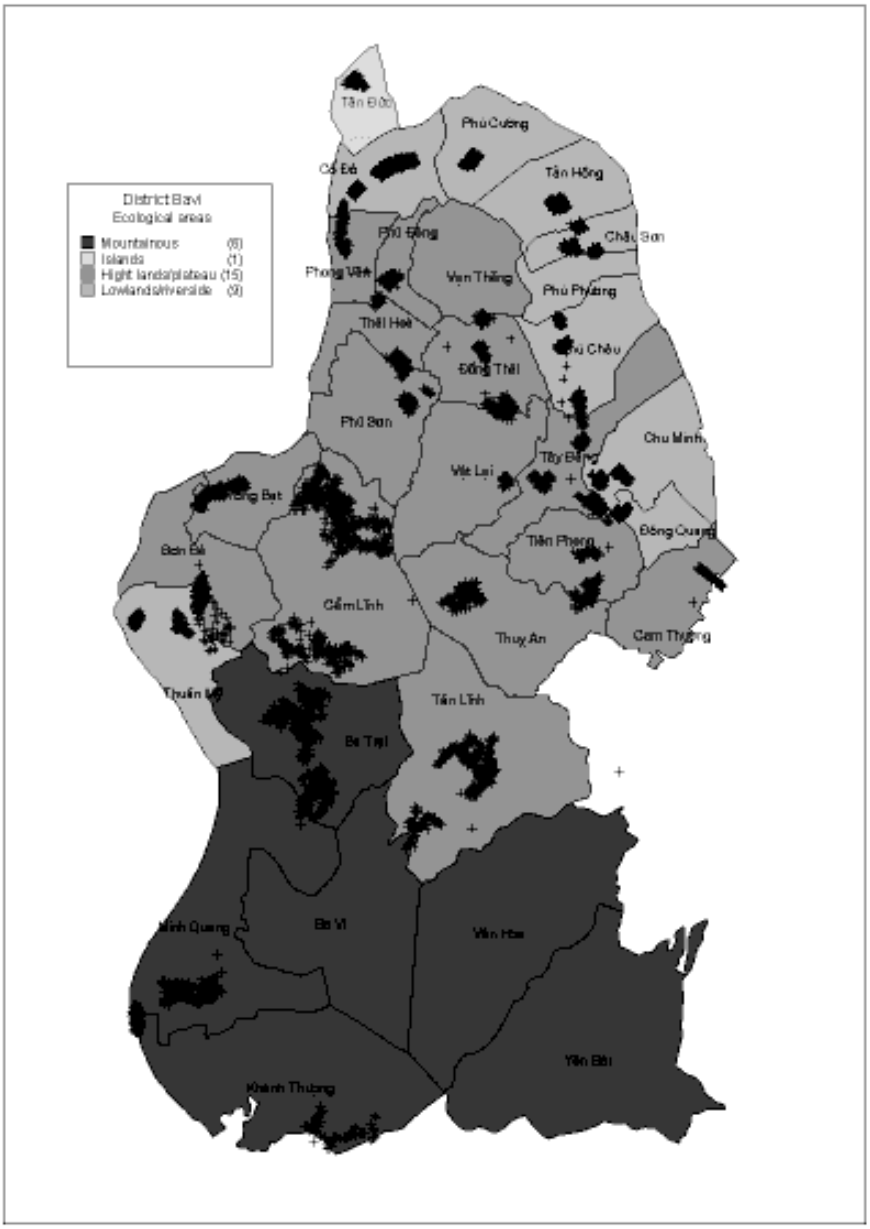
Figure 3. Outline of publications

CHAPTER II: MATERIALS AND METHODS

2.1. Study setting

The study setting was Bavi district, Hatay province, in northern Vietnam. The province is situated in the Red River Delta Region, which is one of the two largest Delta Regions in Vietnam, and is the main source of rice production for the northern part of the country. The district is 60 km west of Hanoi (Figure 4) with a population of about 235,000 (in 1999), and covers an area of 410 km^2, including lowland, highland and mountainous areas. The climate is typical of Northern Vietnam which has four seasons [65].

(a) VIETNAM



(b) **BAVI DISTRICT**

Figure 4. Location of the study setting

The main economic activities for local people are agricultural production and livestock breeding (81%), with major products being wet rice, cassava, corn, soya beans, green beans and some fruits (e.g. pineapple, mandarin, papaya). Other economic activities are forestry (8%), fishing (1%), small trade (3%), handicraft (6%), and transport (1%). The average income per person per year in 1996 was 290 kg rice (equivalent to about 600,000 Vietnamese dong (VND) or 48 USD).

There is one general district hospital with 200 beds, composed of several inpatient departments (internal medicine, surgery, paediatrics, gynaecology, etc.). The total staff amounts to about 120 people, of which about one quarter are doctors. On average, the hospital provides 174,500 consultations and treats 16,500 in-patients every year. The occupancy rate is always over 100%. There are 32 CHSs in Bavi district, one in each commune. Twenty-one of these CHSs are under the direct supervision of the Bavi District Health Center, while eleven CHSs are supervised and supported by three polyclinics. There are three private pharmacies (with licenses), a few private practitioners, and some small-vendor pharmacies in local markets.

2.2. Study base

This study was carried out within the Epidemiological Field Laboratory of Bavi (FilaBavi). In 1999, FilaBavi was set up in Bavi district as part of the Health Systems Research Cooperation Programme between Sweden and Vietnam. The programme is financially supported by the Swedish Government through the Swedish International Development Cooperation Agency (Sida/SAREC). FilaBavi is also a member of the INDEPTH Network.

The district was selected for the field laboratory because it was heterogeneous in terms of geographical characteristics, was considered to be typical for the northern part of Vietnam in socio-economic and health status, had competent local authorities and health leaders strongly committed to the project, and was a reasonable distance from Hanoi, allowing day visits from Hanoi and facilitate supervision.

The overall objectives of FilaBavi were to develop an epidemiological surveillance system, generate basic health data, supply information for health planning and serve as a basic sampling frame for health system research, especially intervention studies [65].

The FilaBavi sample size was calculated based on an estimated infant mortality rate (IMR) of 45 per 1,000 live births and an under-five mortality rate (U5MR) of 60/1,000. The aim was to assess IMR after three years of study, and to show differences in IMR between equally sized groups in the magnitude of 15 per 1,000. This could be achieved with approximately 20% of

the total population. A random sampling of clusters, with probability proportional to population size in each unit, was performed, and 67 population clusters were selected with a reported population size of 51,024 inhabitants in 11,089 households among the total of 238,352 people in 352 clusters (a cluster was defined primarily based on an administrative unit – usually a village, although if the population was large, a village could be divided into two clusters. On average, each cluster should have 600 to 700 inhabitants).

The organization of FilaBavi includes steering committees, project manager, research students, surveyors, field surveyors, field manager, and computer staff. The central steering committee is mainly responsible for technical and policy guidance of the field laboratory with members representing the MOH; Health Strategy and Policy Institute, Hanoi Medical University, and Bavi District People's Committee. The District steering committee is mainly responsible for supporting practical management and implementation of the field laboratory in the District. Members of this committee include Bavi District People's Committee, Bavi District Health Centre, Hanoi Medical University and research students.

There are 39 surveyors divided into six groups, each led by one field supervisor. The criteria used for selecting surveyors were women, living in the district, who had completed high school education. As local people, surveyors can better understand the life-style and culture of the community. It was also convenient for them to visit households frequently if they lived locally. All of them are trained and frequently updated in order to ensure the quality of data collection. Six field supervisors with a medical background, such as assistant doctors or nurses, were recruited. Each of them was responsible for a group of about seven surveyors.

Three computer staff and one supervisor work in the FilaBavi office, located at the District Health Centre. The computer staff have high school education, basic computer skills, and relevant training. The field manager is mainly responsible for coordinating field work activities.

FilaBavi has a well-established data collection system. A baseline census was performed at the beginning of 1999 to collect basic information, and a follow-up census every two years has

updated background data. Data includes information on the individual: age, sex, marital status, educational level, occupation; and on the household: housing condition, water source, assets, debt, average income and expenditure. Follow-up household surveys have been carried out quarterly, noting all events/changes that have happened in the family during the previous three months including death, birth, pregnancy, marriage, migration, illness, and health service utilization. Surveyors are responsible for collecting field data in household interviews, and each is in charge of about 300–400 households. Besides checking manually all survey forms, field supervisors also conduct re-interviews on approximately a five percent sample of the home visits per quarterly survey round. Feedback was given to the interviewers in weekly meetings.

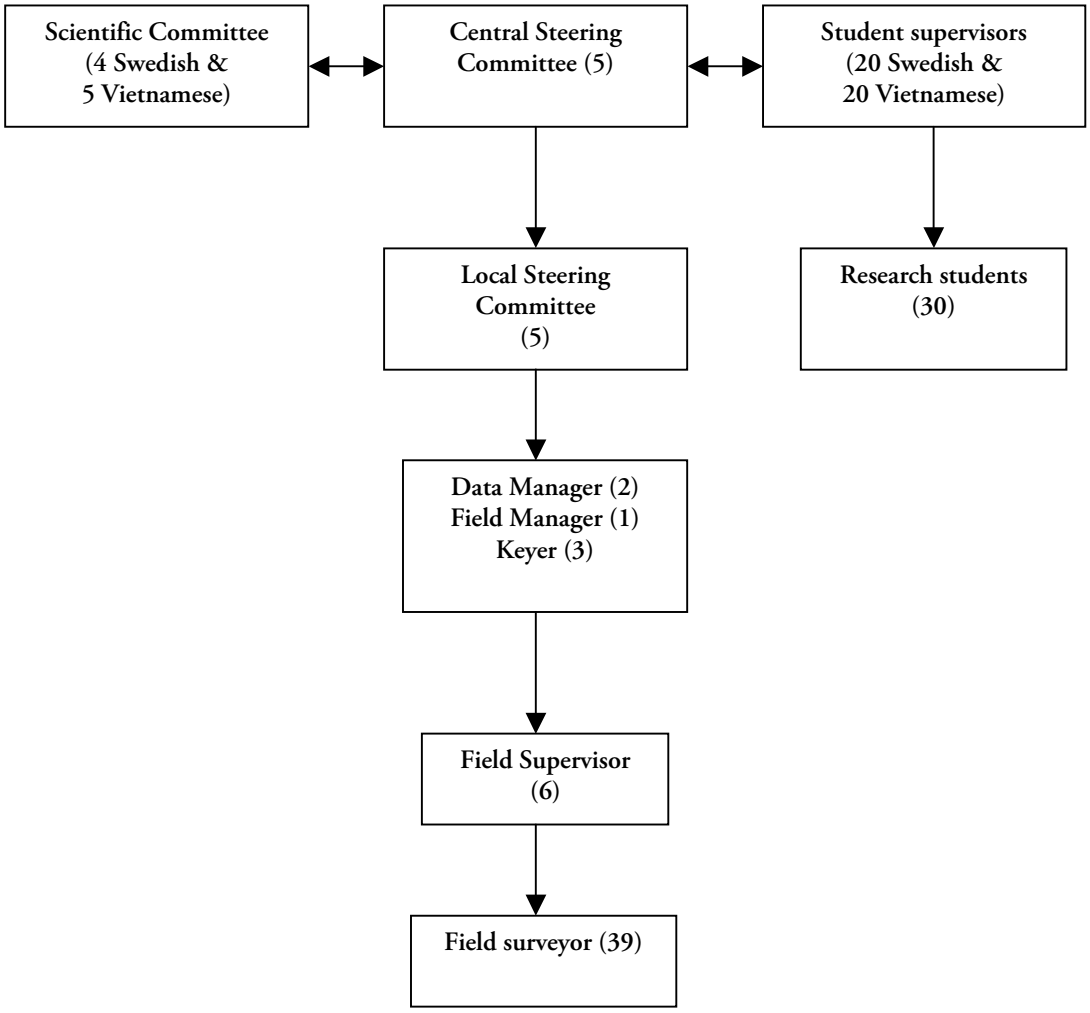


Figure 5. FilaBavi Organizational Structure

Data collection issues and procedures have been developed collaboratively by Vietnamese and Swedish experts, and training courses were given before each survey. Data quality is assured by re-checking systems implemented by different responsible people. Apart from field supervisor checking, 5% are re-interviewed by research students; 20% of collected questionnaires are desk-checked before computer entry. A database system using Microsoft Access was developed locally to handle the data. Data files are frequently backed up onto zip disks and CD-ROMs, and completed forms are filed systematically in the office. Data processing and analysis has been done jointly by Vietnamese and Swedish experts, and research students have linked field lab results with their own specific studies [65].

2.3. Collection of mortality data and the verbal autopsy performance

The pilot VA study was carried out in 1999 and the main study followed from 2000 to 2003. VA interview has become a routine data collection activity in FilaBavi. After the pilot study, some revisions were made in order to improve the procedure. Table 4 below compares VA performance between the pilot study and the main study.

Staff

Interviewers: Since 2000, only six field supervisors have been VA interviewers, while previously all 39 lay field surveyors were used. All of them received special training in conducting the VA interview. The content of the training programme included not only interviewing skills but also how to recognise some signs and symptoms of common diseases in order to help them identify health problems and collect information better. The training was repeated every year by the investigator and medical experts in Hanoi Medical University.

*Assessor*s: Two physicians were involved in the diagnosis procedure. Both of them were general practitioners. At the beginning of the study, one physician had been working as a consultant at a central hospital for seven years and the other had eight years' working experience at a district hospital.

Investigator: The author had the responsibility for designing the questionnaire, training interviewers, supervising data collection and being involved in the diagnostic procedure with the clinical physicians.

Table 4. Comparison of VA performance in the 1999 pilot study and the main study since 2000

Content	VA in 1999 (Pilot)	VA 2000 – onward
Interviewer	39 lay field surveyors	Six field supervisors with medical background
Questionnaire	One common questionnaire	One common form for general information, plus three separate forms for infant, children from 1 to 5, and above.
Structure of the questionnaire	Three main parts: 1- General information; 2- Open medical history and 3- Filter questions for specific signs and symptoms.	The same structure but more questions were added
Assessor	Two general physicians, one has been working at a district health hospital, and the other has been working at a central hospital	
Final decision on cause of death	Discussion between the two physicians for disagreement cases. If no consensus, it was assigned as inconclusive.	Discussion between the two physicians for disagreed cases and a third physician was consulted for disagreed cases. If two out of three agreed, then the cause was assigned, if no consensus, it was concluded as inconclusive

Questionnaire *(VA form: Cause of death ascertainment - see Appendix)*

In the pilot study, a single form was employed to ascertain cause of death for all ages. The form included both open-ended and closed questions in three parts. The first part was general information covering the identification of the household and main informant. The second part included an open-ended question which allowed the respondent to freely describe the circumstances leading to the death and this was recorded directly in note form. The third part was a checklist of signs and symptoms, each starting with a filter question to define its

relevance to the case. If the deceased had the sign or symptom, detailed enquiries about it would follow in a series of closed questions, such as characteristics of the symptom and duration. For example, from the filter question asking "did the deceased have fever?", the "yes" answer led to detailed questions about fever. A medical history of the deceased was also included in the questionnaire. If the deceased had been admitted to any health facility during their last illness, then a copy of their medical record (diagnosis and treatment) was requested.

Since 2000, three separate forms have been used to acquire information on cause of death for three different age groups: infants, children from 1 to 5 years, and people of 5 years and above. The structure of these questionnaires was similar to that of the original one but more specific questions, especially those related to specific age groups, were added. The new questionnaire followed the INDEPTH Standard VA Questionnaire [66] for the purpose of cross-site comparisons, and to include more detailed questions on signs and symptoms in different age groups.

Period of data collection

Routine follow-up collection of mortality data started from January 1999 (the first surveillance round). The pilot VA study was administered from the beginning of the first surveillance round until the end of March 2000 (the fourth surveillance round) in order to record the total number of deaths in the whole year of 1999. The following main VA study continued since 2000. Because the data collection was implemented continuously in the same population, missing cases in the previous year could be found in the following years and were added to the final five–year data for analysis.

Working procedure

Quarterly, the surveyors visited households and asked if there had been any demographic changes in the households (e.g. death, birth, marriage, pregnancy, migration) and filled in the corresponding surveillance forms. If any death occurred, the VA form was used. For this form, the respondent was the relative who mostly took care of the deceased during their last illness. In 1999, while 39 field surveyors carried out the VA interview, every week they submitted

their forms to the field supervisors to be checked and 5% of them were re-interviewed randomly by supervisors. Since 2000, field supervisors have done the VA interviews and these were checked by research students. Then, all filled VA forms were forwarded to assessors to make diagnoses. For any form in which the information was not detailed enough to make a diagnosis, re-interview was required. Figure 6 shows the detail procedure of the VA processes.

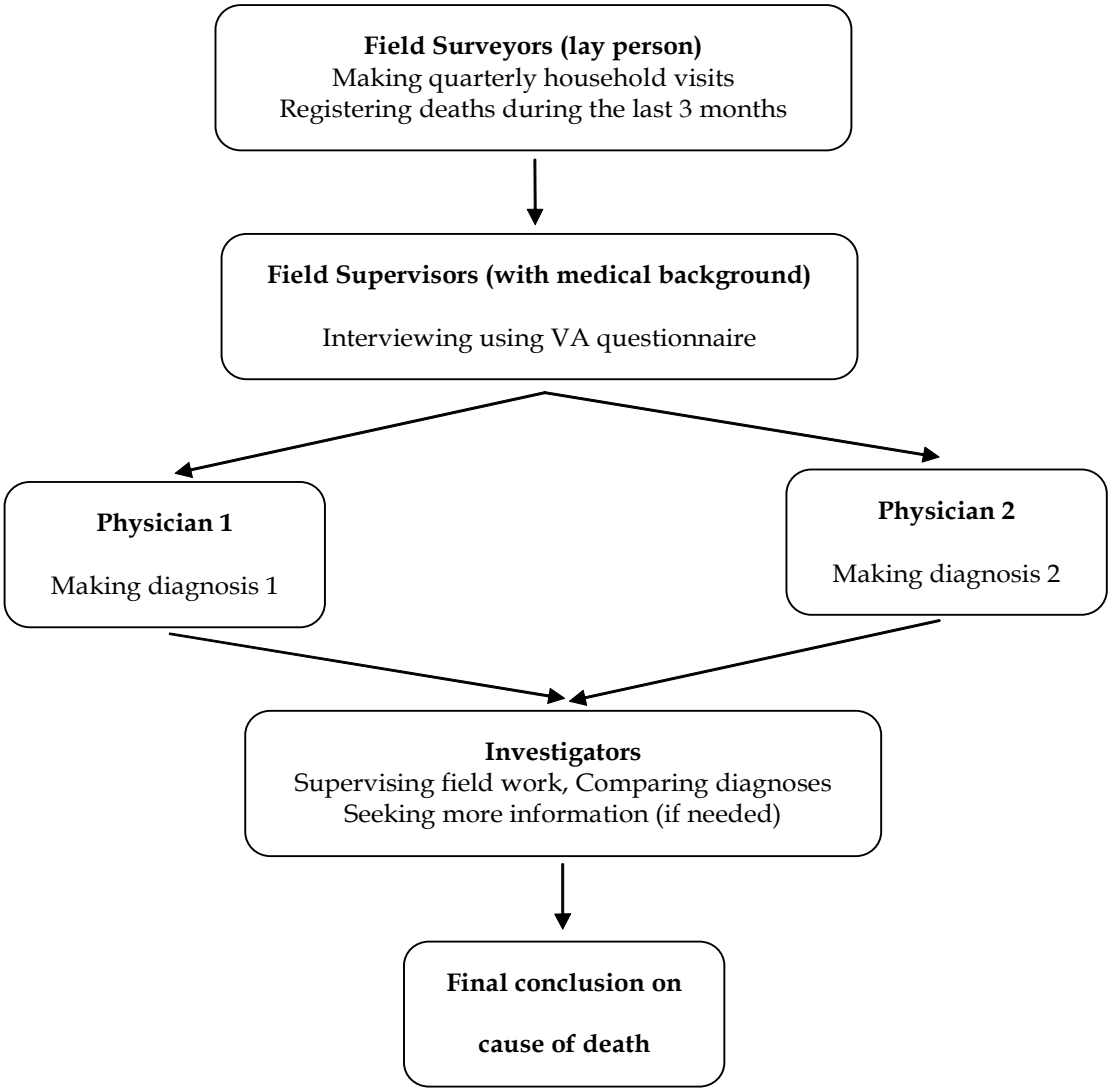


Figure 6. Verbal autopsy procedure

Diagnosis deriving method

When VA forms had been completed, they were forwarded to two physicians who were in charge of determining the CoD. They made their own diagnoses independently based on signs and symptoms reported in the VA forms. Any contrasting conclusions were discussed (in 1999) or later referred to the third referee (since 2000). A CoD was taken as definite when two out of three opinions agreed. If agreement could not be achieved, then the case was defined as inconclusive. Only one most probable diagnosis was made, which could reasonably be considered as the underlying cause of death. For the classification of mortality, this study used an "open approach", meaning that the classification was defined *post hoc* on the basis of the diagnoses derived from the VA [67] and coded following the International Classification of Diseases, version 10 [68].

Praying for the deceased person before the interview

A VA interview in the field

2.4. Measuring premature mortality and calculating life expectancy

For measuring the burden of premature mortality, the Standard Expected Years of Life Lost (SEYLL) method was applied from the GBD study [69] in order to improve the comparability of results between different studies. Discounting but no age weighting was used. YLL for a given cause, age and sex from the corresponding number of deaths N as follows:

$$YLL = N\,Ce^{(ra)} / (ß + r)^2 [e^{-(ß+r)(L+a)} [-(ß + r)(L+a) - 1] - e^{(ß+r)a} [-(ß + r)a - 1]]$$

where r is the discount rate (GBD standard value is 0.03), C is the age-weighting correction constant (GBD standard value is 0.1658), ß is the parameter from the age-weighting function (GBD standard value is 0.04), a is the age of onset, and L is the duration of disability or time lost due to premature mortality [69].

The YLL for a specific cause in the population is obtained by summing all individual YLL of death from specific diseases. This can then be expressed as a percentage corresponding to the YLL from a specific cause out of the total YLL from all causes.

Life expectancy at birth (with 95% confidence intervals) for males and females was calculated based on life tables constructed using revised Chiang methodology, advised by the Office for National Statistics, United Kingdom [70].

2.5. Statistical methods

Following the diagnosis, the VA form was entered to the computer and analysed using STATA v8.0. Kappa statistics were used to measure diagnostic agreement between the two physicians.

Mortality rates were calculated using the person-year approach for different CoDs and by sex, with 95% confidence intervals (CI). Follow-up time was defined as the period between entry and exit from the cohort. A Cox proportional hazards model was used to investigate the association of SES with CoD groups. Adjusted and crude hazard rates (HRs) were compared in order to take confounding into account.

2.6. Main definitions and variables

- Underlying cause of death: underlying disease or injury, which initiated the train of morbid events leading directly to death, or circumstances of the accident or violence, which produced the fatal injury [11].
- Socio-economic status: estimated by assessing educational level, and current economic condition of the household.
    - Educational level of the study subjects was classified into three groups in paper **III** (1- no formal education, including illiteracy); 2- primary: up to 5 years; 3- secondary and higher, and two groups in paper **IV** (1-no formal education, including illiteracy, 2-completion of any level of schooling). These differences arose due to limited sample size.
    - Economic condition of households was described as three groups in paper **III** (1- poor, 2- average and 3- fair and rich), and two groups in paper **IV** (1- poor, and 2- non-poor), according to Bavi District local classification.

2.7. Ethical considerations

The study was conducted within FilaBavi, which benefits from the strong commitment support and collaboration from the local authorities. The research protocol was approved by the Ministry of Health in Vietnam. In addition, all human subjects in the study were asked for their consent before collecting data, and all had complete rights to withdraw from the study at any time without any threats or disadvantages. The Research Ethics Committee at Umeå University has given ethical approval for the FilaBavi household surveillance system, including data collection on vital statistics (reference number 02 – 420). This specific study was also approved by the Scientific and Ethical Committee in Medical Research, Hanoi Medical University.

CHAPTER III. RESULTS

3.1. Verbal autopsy method application

In five-year period from 1999 to 2003, a total of 1,240 deaths were recorded in FilaBavi. VA interviews were successfully completed in 1,220 cases. The other 20 cases were missed because the interviewers could not find the appropriate respondents, either because they had migrated or no one witnessed the death. Since data collection was implemented by continuously following the same population, missing cases in the previous years could be traced and completed in the following years. No case of refusal has been identified so far in FilaBavi. This section describes the implementation of VA in terms of interviewer, respondent, recall period, and diagnostic methods.

Interviewer

During 1999, the total number of interviewers who carried out VA interviews was 39, while since 2000 it has been done by six supervisors. In the pilot study, the lowest number of interviews per person was one and the highest was 13, thus giving an average of about five interviews per person. In the following four years, on average, each field supervisor carried out 40 interviews annually. Of the total 189 interviews in 1999, 10 (5.3%) were re-interviewed by field supervisors as a routine check, 12 (6.3%) by researchers randomly, and another 15 (7.9%) required re-interview because of insufficient information. Later, in the main study the total of re-interviews required for getting more information was about 5%. Spot checks were performed for about 4% interviews randomly by researchers during the period of 2000-2003.

Respondent

The criterion for respondents for VA interviews was that they be the person who mostly took care of the deceased person or who knew the most about the illness prior to death or at least had witnessed the death. Table 5 below shows the relationship of the main respondents to the deceased.

Table 5. The relationship of the respondent to the deceased according to the deceased's age, FilaBavi 1999 - 2003

Age of deceased	Relationship of the respondent to the deceased				Total
	Parents	*Offspring*	*Spouse*	*Others**	
Under 1 year old	40	0	0	35	75 (6.2%)
1 - 4 years old	17	0	0	3	20 (1.6%)
5 - 15 years old	24	0	0	13	37 (3.0%)
16 - 49 years old	65	8	91	12	176 (14.4%)
50 - 70 years old	0	112	95	50	257 (21.0%)
Over 70 years old	0	402	138	115	655 (53.7%)
Total	146 (12.0%)	522 (42.8%)	324 (26.6%)	228 (18.7%)	1220 (100%)

** Others: relatives or neighbours*

Recall period

Table 6 presents the distribution of recall periods in the pilot and main studies. Mean recall periods were 8.5 months and 4.5 months, while medians were 7 months and 6 months, in the pilot and the main study, respectively.

Table 6. The distribution of VA recall period, FilaBavi 1999 - 2003

Recall period *(month)*	In 1999 *n (%)*	During 2000 – 2003 *n (%)*
1	2 (0.9)	0 (0)
2	5 (2.3)	61 (6.1)
3	18 (8.1)	**460 (46.0)**
4	9 (4.1)	145 (14.5)
5	16 (7.2)	102 (10.2)
6	24 (10.9)	98 (9.8)
7	**43 (19.5)**	57 (5.7)
8	18 (8.1)	22 (2.2)
9	12 (5.4)	22 (2.2)
10	15 (6.8)	15 (1.5)
11	12 (5.4)	8 (0.8)
12	15 (6.8)	6 (0.6)
> 12	32 (14.5)	3 (0.3)
Total	**221 (100)**	**999 (100)**

Diagnostic methods

The diagnoses of CoD were made by two physicians separately and then compared. Figure 7 shows the comparison of diagnoses between two physicians. Kappa statistics were used to measure the agreement between the two physicians, with $\kappa = 0.84$ (95% CI 0.78 – 0.90) in

the pilot study (see Figure 1 – Paper I) and κ = 0.87 (95% CI 0.80– 0.92) in the main study, which indicate *very good* agreement [71].

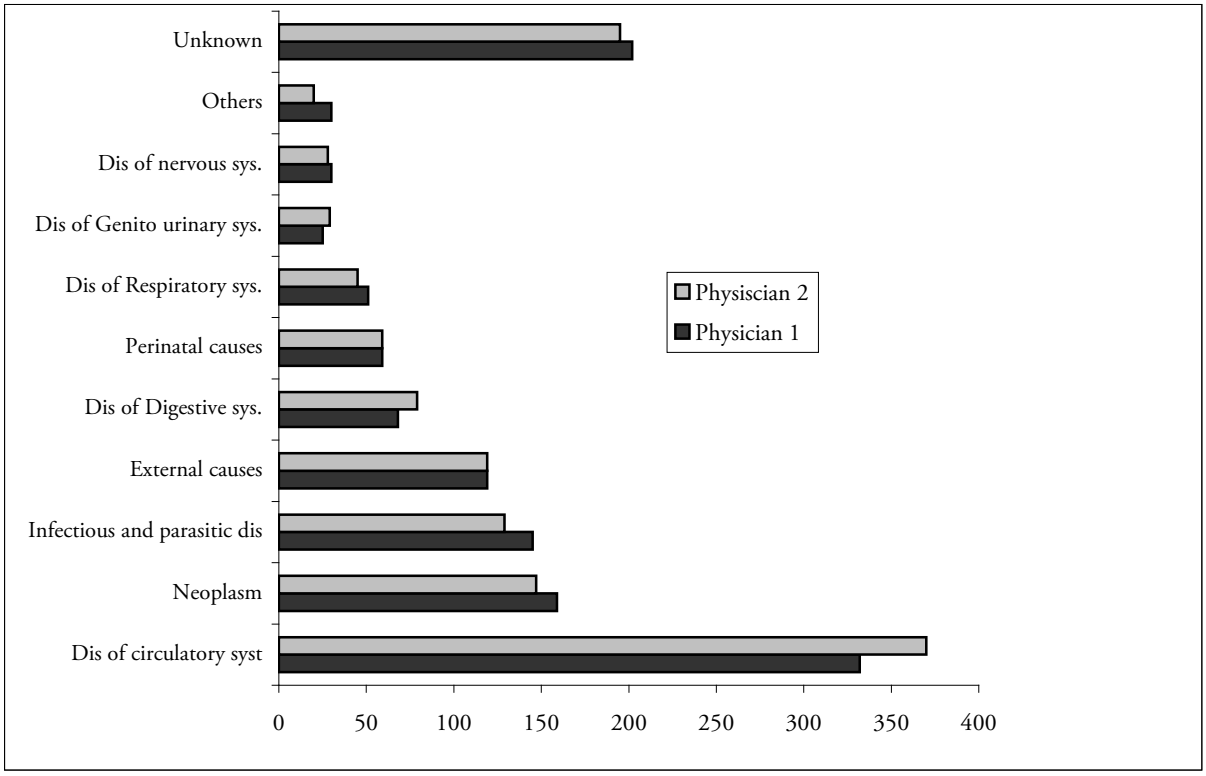


Figure 7. Comparison of VA diagnoses by two physicians, FilaBavi 1999-2003

3.2. The pattern of mortality in transitional Vietnam

The total number of deaths recorded in the study area was 1,240 over five years in population under surveillance of 240,538 person-years, thus giving a crude death rate of 5.1 per 1,000 person-years. Sex-specific rates were 5.7 per 1,000 person-years for males and 4.5 for females. Direct standardisation using the WHO standard population [72] gave a rate of 5.7 per 1,000 person-years, 8.4 for males and 3.9 for females. Using the revised Chiang methodology [70], the estimated life expectancy at birth was 75.7 years overall (95% CI 75.1-76.4), 71.0 for males (95% CI 69.9-72.1), and 80.9 for females (95% CI 79.9-81.9).

Data in the five-year period were aggregated for analysis in order to have a bigger data set since the distribution of CoD was generally consistent over the whole period. Figure 9 summaries the five-year specific CoDs for males and females. Overall, diseases of the circulatory system, malignant neoplasms, infectious diseases and external causes (both unintentional and

intentional) were leading causes of death for both males and females, accounting for 28.9%, 14.5%, 11.2%, and 9.8% of the total mortality, respectively.

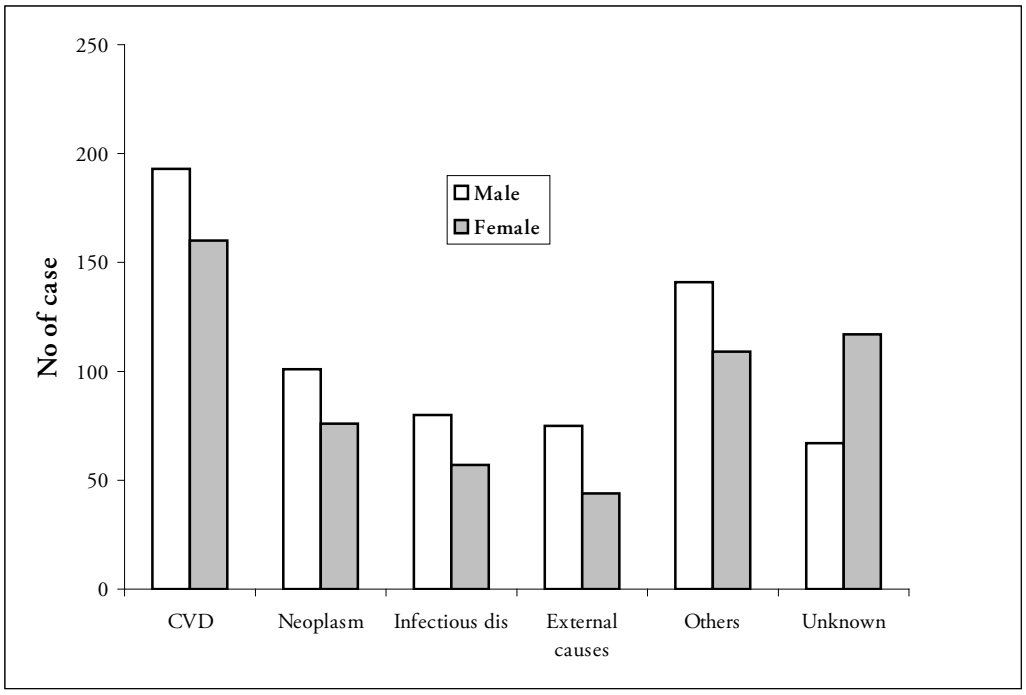


Figure 9. Distribution of main causes of death for males and females, FilaBavi 1999-2003

Table 7 ranks causes of death by different age groups. Because there were relatively few cases of death among children and young adults, some diseases categories had no cases. There was a total of 75 infant deaths (44 among boy, and 31 among girl) during five years. The most common causes were low birth weight and premature delivery, accounting for 34.7% of the total. Congenital malformation and other causes originating in the perinatal period shared relatively equal numbers of death (17 and 16 cases, respectively). Infections caused 10 deaths.

In children aged one to five years, external causes, specifically drowning, was the leading cause of death, and a greater burden for boys (7 cases) than for girls (2 cases). Pneumonia and meningitis were also common diseases that killed children in this age group.

There were a total of 47 deaths in the age group from 5 to 19 years, in which 27 cases were due to external causes, mostly drowning (20 cases). The remaining 20 cases were distributed among various causes, including infectious diseases in six cases.

For the adult population, aged 20 and above, the most common cause of death was CVDs, accounting for 32%, mainly comprising cerebro-vascular diseases (n=212 (61.6%), and heart failure (n = 66 (19.2%). Malignant neoplasms ranked second, accounting for nearly 16% of the total. These were most commonly liver and stomach cancers in both males and females (23% and 19% respectively); cancer of the respiratory system and intra-thoracic organs (23% in males, 11% in females), and breast and reproductive system cancers in females (5% and 4% respectively). Infectious diseases accounted for about 11% of the total, of which almost half were due to respiratory infections and tuberculosis, with meningitis and digestive infections were also common. Around 7% of the total deaths were caused by injuries, mainly unintentional. Overall, injuries were more prevalent among younger men, although this varied by type of injury. While the majority of motor vehicle accidents and drowning occurred among younger men, fractures, mainly of the hip and pelvis, were concentrated among women over 75 years old.

Table 7. Ranking major causes of death by age group in FilaBavi, 1999-2003

Under 1 year n=75 (%)	**1 – 4 years** n=20 (%)	**5 – 19 years** n=58 (%)	**20 – 49 years** n=177 (%)	**50 – 74 years** n=453 (%)	**75+ years** n=437 (%)	**Overall rank n=1220** (%)
Perinatal conditions (77.3)	External causes (45.0)	External causes (57.5)	CVD (21.5)	CVD (35.1)	CVD (33.6)	CVD (28.9)
Infectious diseases (13.3)	Infectious disease (30.0)	Infectious diseases (17.0)	Neoplasm (20.9)	Neoplasm (23.8)	Senility (27)	Neoplasm (14.5)
External causes (4.0)	Neoplasm (10.0)	Neoplasm (12.8)	External causes (19.8)	Infectious diseases (10.5)	Infectious diseases (10.5)	Infectious diseases (11.2)
Dis. of digestive sys. (1.3)	Dis. of digestive sys. (5.0)	Dis. of nervous sys. (4.3)	Dis. of digestive sys. (10.7)	Dis. of digestive sys. (6.4)	External causes (5.3)	Senility (11.1)
-	Dis. of digestive sys. (5.0)	CVD (4.3)	Infectious diseases (9.0)	Other NCD (4)	Neoplasm (4.6)	External causes (9.8)
-	-	Dis. of genitor urinary (2.1)	Dis. of genitor urinary (6.2)	External causes (3.8)	Dis. of respi. Sys. (4.6)	Dis. of digestive sys. (5.8)
-	-	Others (2.1)	Dis. of nervous sys. (1.7)	Senility (3.8)	Dis. of digestive sys. (3.9)	Perinatal conditions (4.8)
-	-	-	Other NCD (1.1)	Dis. of respi. Sys. (3.5)	Dis. of nervous sys. (2.3)	Dis. of respi. Sys. (3.0)
-	-	-	Dis. of respi. Sys. (0.6)	Dis. of genitor urinary (2.4)	Dis. of genitor urinary (1.4)	Dis. of genitor urinary (2.5)
-	-	-	-	Dis. of nervous sys. (1.5)	Other NCD (0.7)	Other NCD (2.0)
Inconclusive (4.0)	Inconclusive (5.0)	-	Inconclusive (8.5)	Inconclusive (4.2)	Inconclusive (6.2)	Inconclusive (4.0)
100%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

3.3. Measuring premature mortality

Figure 8 shows the proportions of YLL and the corresponding cause-specific proportions of mortality for the total 1,220 deaths. The line of equality (y=x) is shown so that causes where the population burden exceeded its simple proportion of mortality are shown above and to the left of the line. Many points lie close to the line of equality. Infectious diseases, diseases of genito-urinary system, respiratory system, and nervous system are represented by similar percentages of YLL and mortality.

There were some obvious differences between these two mortality indicators for specific diseases. The population burden of premature deaths from circulatory system diseases is rather less than suggested by the proportion of mortality. On the other hand, the population burdens of premature deaths arising from malignant neoplasms, external causes and perinatal causes are rather higher.

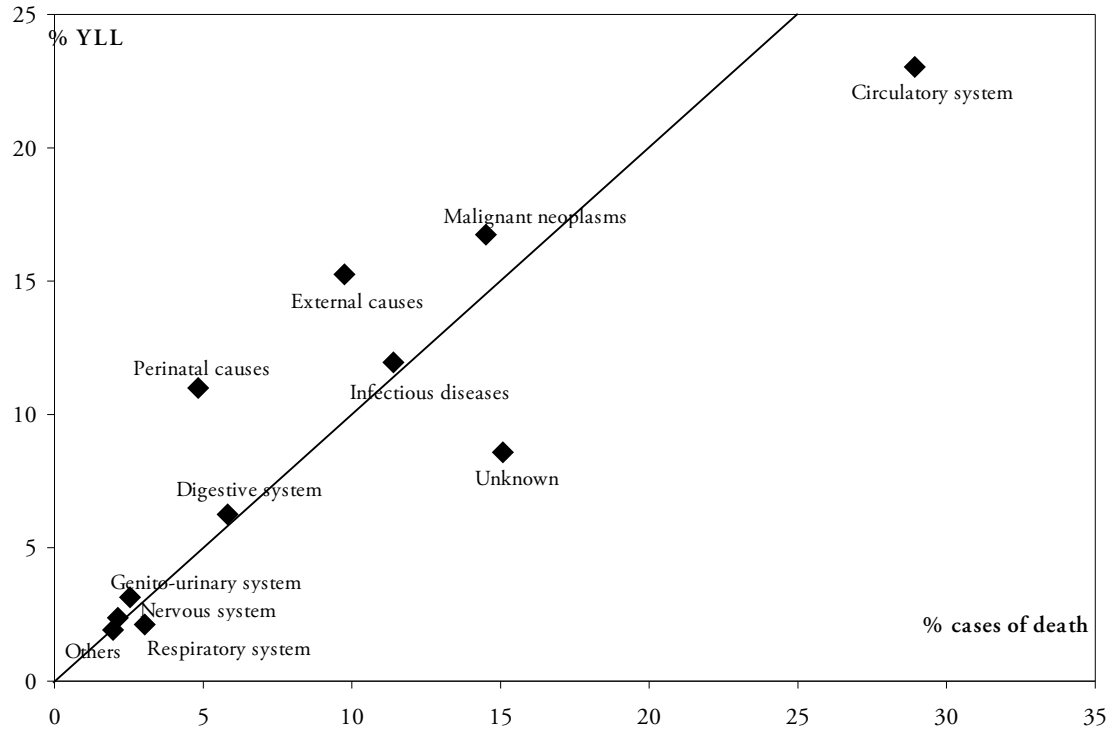


Figure 8. Years of life lost (YLL) versus crude mortality, FilaBavi 1999–2003

3.4. The association between cause specific mortality and socio-economic status

The relationship between SES and major causes of death in adults aged 20 years and above were examined. The cohort comprised 14,289 men and 16,713 women aged 20 years and above at the beginning. During the five-year follow up period, there were a total of 1,067 deaths, of which 572 among men, and 495 among women, occurring among 137,172 person-years in the cohort population, accounting for 86.7% and 88.4% respectively of the total deaths.

Table 8. Multivariate Cox proportional hazards regression model for three major mortality categories in adults (aged 20 years and over) by age, education and household economic status (HES) in FilaBavi, 1999-2003.

	Communicable diseases		NCDs		Injuries	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
Age group						
20-49	1	1	1	1	1	1
50-74	9.8 (4.6 – 20.8)*	1.3 (0.3 – 5.8)	8.9 (6.6 – 11.8) *	5.4 (3.1 – 9.4) *	1.0 (0.4 – 2.2)	1.3 (0.2 – 7.2)
75 +	16.3 (6.0 – 43.9) *	10.3 (2.2 – 48.2) *	19.3 (13.1 – 28.6) *	20.2 (10.9 – 37.1) *	3.0 (1.0 – 9.4)	12.6 (2.0 – 78.7) *
Education						
Illiterate	1	1	1	1	1	1
Primary	0.7 (0.4 – 1.4)	0.5 (0.2 – 1.4)	0.7 (0.5 – 0.9) *	0.6 (0.4 – 0.8) *	0.6 (0.2 – 1.7)	0.9 (0.2 – 3.1)
Secondary & higher	0.3 (0.1 – 0.7) *	0.0 (0.0 – 0.3) *	0.4 (0.3 – 0.5) *	0.4 (0.2 – 0.7) *	0.3 (0.1 – 0.9) *	0.3 (0.0 – 2.1)
Household economic status						
Poor	1	1	1	1	1	1
Average	0.5 (0.5 - 0.8) *	0.7 (0.3 - 1.7)	0.9 (0.7 - 1.2)	0.9 (0.6 - 1.2)	0.6 (0.3 - 1.2)	0.7 (0.2 - 1.9)
Rich	0.2 (0.1 - 0.5) *	1.3 (0.5 - 3.2)	0.7 (0.5 - 1.0)	0.9 (0.6 - 1.3)	0.4 (0.1 - 1.1)	0.5 (0.1 - 1.9)

*Note: Figures in brackets are 95%CI; * shows statistical significance*

Table 8 above shows hazard ratios for three major mortality categories for men and women, adjusting for age, education, and household economic status. Since CVD were responsible for

the largest part of mortality in the setting, a similar analysis was performed on CVD mortality and the selected SES indicators. Results are shown in Table 9.

Table 9. Multivariate Cox proportional hazards regression model of risk factors for CVD, cancer and other NCD among adults aged 20 years and over, Bavi District, Vietnam,1999-2003

	CVD	Cancer	Other NCD
Gender			
Women	1	1	1
Men	3.3 (2.6- 4.3)*	2.4 (1.7- 3.4) *	2.5 (1.8- 3.6) *
Age group			
20-49	1	1	1
50+	13.3 (9.1- 19.4) *	7.8 (5.2- 11.7) *	9.7 (6.3- 14.9) *
Education			
Primary and higher	1	1	1
No formal education	4.5 (3.4- 5.8) *	1.5 (1- 2.3)	2.0 (1.3- 2.9) *
Economic status			
Poor	1	1	1
Non poor	1.1 (0.8- 1.6)	0.7 (0.5- 1.1)	0.7 (0.4- 1.0)

*Note: Figures in brackets are 95%CI, * shows statistical significant value*

Table 8 and Table 9 show that SES had a strong relationship with cause specific mortality. Education seemed to be a protective factor for communicable disease mortality in both men and women. Being highly educated could hugely (and significantly) reduce the probability of dying from NCDs, in both men and women, and the probability of dying from injuries in men (Table 8). Significant results were also observed when analyzing the association between education and NCD specific causes of death, especially CVD (Table 9). Those with no formal education had 4.5 times, 1.5 times, and 2 times greater risk of those with primary and higher education of dying from CVD, cancer, and other NCD, respectively.

Household economic status only played a role as a protective factor from mortality of communicable diseases among men. In CVD causes, no significant difference was observed.

CHAPTER IV: DISCUSSIONS

4.1. Methodological issues

The application of VA in the Vietnamese context

Even though VAs have been applied widely to ascertain causes of death in many studies in developing countries since the 1960s [73], the use of this method is not common in Vietnam and has mainly been used in some small studies focusing on maternal or infant death [1, 74]. When Filabavi started collecting longitudinal demographic data in 1999, VA was first piloted, and since 2000, it has become a routine activity for acquiring information on causes of death across all ages in this setting. So far, 25 sites of the INDEPTH Network are using VA on a regular basis but with varying procedures and performance [75, 76]. Issues related to the use of this method in the rural setting of Vietnam have been considered in this study, which can further contribute to the extension of this method at the country level or elsewhere.

- *Interviewers*

Results from the pilot study in 1999 showed that 39 interviewers were too many for carrying out VA interviews effectively in this study area. There were several interviewers who performed only one interview during the study period and therefore possibly did not gain enough experience of using the questionnaire. A large number of interviewers can also produce diversity in the results. Consequently, 37 out of 189 cases (20%) were re-interviewed, randomly checked up or required additional information. Some studies have reported the use of lay reporters to conduct verbal autopsies and found that the resulting diagnoses correlated well with those conducted by professionals [77]. But from this study, we suggest that in the FilaBavi context, using people with some basic medical background such as midwives, nurses or assistant doctors is helpful. With some basic medical knowledge, they can perhaps more easily promote conversation about medical issues with respondents, as well as recognising the signs and symptoms of the deceased person more clearly. Therefore, since 2000, six field supervisors, who have medical background and good skills in doing fieldwork, have been recruited as VA interviewers. Nonetheless, as has been mentioned in some studies, when medically trained interviewers are used, attention should be paid in order to avoid subjective bias because they are more likely than lay interviewers to interpret responses into a diagnosis

during the interview and this may affect the repeatability of the outcome [67]. The VA procedure was improved after the pilot study, which involving death registration by field surveyors as vital events in the family, and then VA interviewing by field supervisors as part of their visiting and sharing the bereavement with the family.

Although no rigorous comparison was performed to compare the two different types of interviewer in the setting, it appeared that field supervisors made fewer mistakes on identifying signs and symptoms of the deceased people than lay surveyors did, which certainly contributed to enhancing VA diagnosis. Within the INDEPTH Network, the background of VA interviewers has varied between sites, depending on available resources and local choices [75]. However, it has been strongly recommended that appropriate and standardised training for interviewers, which covers not only interviewing but also counselling techniques, was essential [75, 78]. This issue was part of the training procedures in the setting.

- *Respondents*

Generally, identifying the most appropriate respondent for adult deaths is difficult because the relationship between caretakers and sick adults is likely to vary in different settings and circumstances. For instance, in maternal death, the husband seems not to be the best respondent because the person taking care of the deceased women is more likely to be a mother or sister, though there is little evidence on the effect of respondents' characteristics on the VA performance. A study done by Chandramohan [79] did not find significant effects of age, sex, relationship, and language of respondents on VA interpretation. However the majority of the respondents in this FilaBavi study had a close relationship with the deceased and had been taking care of the deceased person prior to death, so that the information acquired from them was generally reliable. In cases of infant death, about half of respondents (40/75 cases) were not mother nor father but were grandparents or other close relatives, who were also involved in taking care of the child before death, although from results of other studies, mothers are the principal respondents for childhood deaths [67]. Additionally, cultural and societal factors have also been suggested for consideration in identifying appropriate respondent [18]

Some studies have expressed doubts as to the reliability of uneducated respondents' observations but this has been disproven [80]. Fortunately, in this study area, the adult literacy rate is high, illiteracy being reported in only 0.4% of the adult population, according to local statistics.

- *Recall period*

In the preliminary analysis in 1999, recall period ranged from one to 12 months with a mode of seven. However, missing cases in this year were found in the following years, which then had recall times of more than 12 months. This study has not checked the reliability of the interview in relation to recall period but it has been shown from other studies that longer recall periods can be as reliable as shorter intervals, but too short periods may lead to non-response [80]. It is generally believed that recall does not greatly affect reporting an event as tragic as the loss of a person's life in the family [81]. Some studies have suggested an acceptable recall period from one to 12 months [79, 80]. The implications of different recall periods have not been commonly examined, except in one study showing no significant difference of the result in recall period length of one to 21 months [79]. Not only the validity of information, but also the social and cultural settings should be considered when identifying the time interval. In our setting, it is more important to ensure an appropriate minimum time for the recall period than to set a maximum time, because asking about a death soon after its occurrence may cause distress to relatives, especially in the cases of children or sudden deaths. The VA interview should also be not too long after death to get relevant information from respondents and, for practical reasons, it should be within the period when the deceased's relatives are still around the house to pray and to receive visitors before going out to work. In our field context, it is suggested from the pilot study that the possibility of having a minimum recall period of about one month (when main traditional mourning procedures are over), and the VA should be based on the quarterly surveillance round. Consequently, during the period from 2000 to 2003, 52% out of total interviews were performed within the first three months after death, and only three cases had recall time longer than 12 months.

- *Questionnaires*

A combined format including open-ended questions and checklists of signs and symptoms was used in this study. In the pilot study, the open-ended question was not used as effectively as expected because the lay interviewers did not have medical backgrounds. This part may require more trained and skilful interviewers in order to promote conversation and encourage respondents [82]. In the revised version, time sequence was added in the open history part to remind the interviewer about the onset and circumstances leading to the death. The advantages and disadvantages of open or structured questionnaires for health interview surveys have been discussed elsewhere [83]. However, the relative merits of the various formats of VA questionnaire have not been formally assessed [82]. In general, a checklist with a filter would not require medically trained interviewers and may be efficient for data collection and reduce interviewer bias. This type of questionnaire has been used widely in identifying childhood deaths where only a few causes of death were studied but this format may be less useful for VA for adult deaths because the mortality classification is likely to have a large number of categories of causes of death [82]. In general, using the combined format with a proper design, intensive training of those in charge of filling out the questionnaire and making sure that respondents understand all questions and that their answers are adequate helped to ensure effectiveness and reliability of the study.

- *VA diagnostic methods*

There are different stages of making diagnoses in the VA process, by interviewers at the interview or by assessors, who were different from interviewers, deriving a diagnosis later [67]. In reality, diagnosis derived at a later stage is preferable than that at the interview. The derivation of diagnoses in this study relied on the second option. Because the categories of cause of death in this study are very different and cover all ages, diagnostic algorithms could not be developed beforehand. (A diagnostic algorithm applies standard criteria based on the duration, severity and sequence of symptoms and signs used to reach a diagnosis). Diagnoses derived according to diagnostic algorithms are considered to have a better repeatability compared to diagnoses derived without algorithms, but they are probably more appropriate for some specific causes of mortality such as maternal or infant/child mortality with fewer

causes than in adult all-age mortality [84]. The diagnoses in this study were mostly based on textbooks and clinical experience of the physicians themselves, which might lead to low repeatability [67]. However, an attempt was made to compare VA diagnoses between physicians' diagnoses and a probabilistic model using the same dataset in 1999 [85, 86] and the results were promising, with a high degree of agreement between the two approaches. The application of this type of model in such settings should be considered as an alternative whenever possible in order to increase the repeatability as well as the objectivity of the results.

- *Validation of VA*

Validity is a very important issue when applying VA methods. The validity of VA is influenced by many factors, such as cause of death, characteristics of the deceased, classification of causes of death, the design and content of the questionnaire and fieldwork procedure, etc, as summarised in a Chandramohan's review [67]. The term "validity" means how well a given test reflects the results of another test of known greater accuracy. Validity assumes that there is a gold standard to which a test or observer should be compared. In most developing countries, where medical information outside health facilities is always scarce, comparison with hospital data, which is considered to be the "gold standard", seems the only option to validate VA study result. However, it may not be the optimal solution. Reasons were analyzed by Soleman in her review of the literature and currently used VA tools, such as interviewer information bias, sample selection, different cut-off points for sensitivity and specificity, and quality of hospital records [76]. The greatest concern in the validity of VA diagnosis related to determining CoD for diseases with no distinctive symptoms, such as chronic and degenerative diseases. It was recognised that the generalisation of findings of hospital-based validation studies to the general population is limited, and there is an urgent need to have community-based validation studies across all ages. In addition to validating VA diagnosis, other validations on different types of interviewer, questionnaire, recall time, and different methods of deriving diagnoses are required since they all play important parts in assuring the validity of VA [76].

In the FilaBavi setting, no hospital-based validation study has been performed, due to the limited number of deaths occurring in the hospital (less than 15 cases of deaths in the district hospital were reported every year), and poor information in medical records, both on signs and symptoms of the deceased and on personal identification in order to trace the patient's family. Other considerations were also similar those mentioned above in the WHO report [76]. However, in this study, proper interviewer training and close field procedure supervision hopefully contributed to ensuring the reliability and validity of the results.

- *Ethical issues*

In general, verbal autopsy interviews request information on the circumstances that led to the death of a close relative that can inevitably cause emotional distress to the bereaved family. The degree of distress depends on various factors such as the age and relationship of the deceased, the circumstances of death, the culture of bereavement, recall time, and the behaviour of the interviewer [78]. For example, interviewing a mother about her infant's death or a young woman who has lost her husband can cause psychological distress if the interviewer has little or no training in counselling.

In this study, several solutions were applied to overcome difficulties caused by emotional distress in doing VA interviews. Firstly, techniques of counselling for VA interviewers were included in training package. Behaviour of interviewers is very important; they should be sympathetic and share in the family's loss. The VA procedure here involved lay surveyors to register a death and then make an appointment with the family for the VA interviewer's visit, which was considered to be culturally and socially appropriate and acceptable to the local community. Before the interview, the VA interviewer always requested the family to allow him/her to pray for the deceased in accordance with local cultural traditions, allowing the expression of his/her share in the family's loss.

In public health, aggregated information on CoD is valuable for health planning and priority setting. At the individual level, this information is very sensitive to the deceased family, especially for deaths related to stigmatised diseases such as HIV/AIDS, tuberculosis, suicide, or

sexually transmitted diseases. Generally, family would not want to inform others when a death might leave a bad reputation or bring shame on the family. In this study, confidentiality was treated very conscientiously. Related staff, such as interviewers, data clerks, researchers, and physicians involving in deriving diagnosis, are required to keep information confidentially for research use only and this was included in training session. Only aggregated data on CoD can be made widely available.

Since VA techniques solely depends on interviewing people, voluntary involvement of the respondent is very important, and so it is not only essential to respect the respondent, but this is necessary to ensure the validity of the information acquired. In our study, verbal consent was obtained from families before conducting VA interviews; the informant had complete rights to withdraw from the interview at any time without any threats or disadvantage.

Quantifying the burden of premature mortality

The YLL approach has the disadvantage in the global context of requiring detailed information about age and CoD on an individual basis, which can be especially difficult in low-income countries, like Vietnam. Most estimates for YLL and DALY for these countries have been drawn from models rather than original data. In Vietnam in general and in this setting in particular, the YLL approach has not been used previously to assist in planning health work, probably due to lack of available relevant data, except in a preliminary study in 1999 [87]. This study, taking advantage of the ongoing FilaBavi DSS, attempted to use empirical data relating to approximately 250,000 person-years and over 1,000 deaths in a five year-period, to quantify the burden of premature deaths for priority settings against deaths from specific causes, according to patterns of future life lost. The results hopefully can provide an accurate picture of the mortality burden, especially premature mortality in a typical rural area in northern Vietnam.

The role of DSS in collecting mortality data in Vietnam

Although mortality data have been recognised to be fundamental to evidence-based health policy, not many countries have good systems to generate them with high validity despite

legislation providing for the establishment and maintenance of vital registration systems. Among 115 country members of the WHO reviewed, only 64 countries had reliable data on age, sex and cause of death [22]. According to this evaluation, coverage of death registration is less than 10% in African Region, and in the Western Pacific Region, Vietnam is among 10 countries which has never provided mortality data to the WHO.

Validity of the number of deaths in Vietnam is still questionable, let alone CoDs. A validation study carried out in FilaBavi showed that the formal commune population registration system under-registered 19% deaths, and the re-census (equivalent to a cross sectional survey) missed 4% of deaths in the area, while the FilaBavi DSS only missed one death in the same period [64]. A study in rural Kenya showed similar results, with Government statistics tending to under-report mortality, particularly neonatal mortality, and also providing inaccurate information on CoDs, in comparison with a DSS [88]. In Vietnam, CoD has rarely been collected from the community. The MOH produces statistics on the leading CoDs annually, but data come solely from health facilities, which cannot be representative of what happens in the community, when only less than 20% of total deaths occur in health facilities, and most of them are emergency or accident cases [89]. It is recommended by the WHO that there is an urgent need for countries to collect mortality information, even if only through sample registration like DSS, to improve knowledge on mortality patterns [22]. This study illustrates the fact that the combination of VA methods and a longitudinal DSS can provide useful information to characterise otherwise unavailable mortality patterns in a community, and has potential as a resource for heath planning. A nationally representative sample vital registration system using VA is also an option for the country in order to acquire reliable mortality data in the future, having experience from this study.

4.2. The double burden of mortality in transitional Vietnam

The life expectancy at birth for the Filabavi population during the five-year period was similar to the previous estimate using three-year data from 1999 to 2001 [90]. This result was higher than the WHO estimate for Vietnam in 2002, which concluded life expectancy at birth was 67.1 (95% CI 66.3 – 68.1) for men and 72.2 (95% CI 71.4 – 73.1) for women [54].

The CoDs in FilaBavi reflect a pattern typical of that in developing countries which are in epidemiological transition. In these countries, the ageing of the population, reductions in fertility rate, improvement of preventive and therapeutic control of infectious diseases and modernisation (Westernisation) of lifestyle may contribute to a decrease in the disease burdens attributable to communicable diseases and led to an increase in those attributable to degenerative and man-made diseases and injury. For adults, the leading causes of death are cardiovascular diseases and infectious diseases, reflecting the double burden of mortality. In Vietnam, as in other developing countries, there is a lack of routine cause-specific mortality statistics so that information on mortality patterns for the whole country is not available. A few decades ago, infectious diseases were the leading causes of death with epidemics of tuberculosis, malaria and pneumonia. However with achievements of public health action, such as improvement of health facilities, surveillance for infectious diseases and immunisation programmes, mortality from communicable diseases has decreased considerably. But Vietnam yet has to face another health problem. From hospital data, it appears that non-communicable diseases (NCDs) have been increasing in recent years and are now the first-ranked cause of mortality. In Vietnam Health Statistical Year Books from 1998 to 2005 [57, 60, 89, 91-95] , NCDs, especially CVDs, were always ranked among leading causes of adult death in hospital, which included intracerebral haemorrhage, stroke, heart failure, acute myocardial infarction and hypertension. Comparing with a neighbouring country, Singapore, which has a good mortality data collection system, tuberculosis was the leading cause of death in 1948, since when there has been a rapid increase in the rate of cardiovascular disease which peaked in the early 1980s (2). The estimation of the leading causes of mortality and burden of disease in Vietnam in 2002 by the WHO [54] showed that among 10 leading causes of mortality, seven causes were due to NCDs, while there were only two communicable diseases, lower respiratory infections and TB, ranking the fourth and the sixth of the list. The two leading causes of death in Vietnam were CVDs.

In addition to that, in recent years, recurrent and new communicable diseases, like Severe Acute Respiratory Syndrome (SARS) and avian flu, also have threatened Vietnam. Other infections, such as respiratory infections, meningitis and encephalitis, were still ranked on the

second and the third ranks as killers across all ages in the country. This situation puts the Vietnamese health system in a dual burden situation, facing both NCDs and communicable diseases at the same time.

In this study, results showed that accidents and their adverse effects were ranked fourth among mortality causes. Because FilaBavi is a rural area, the leading type of accident does not involve road traffic as in urban areas, but drowning, which mostly happened to small children. In a follow-up study of child mortality in Bangladesh [96], drowning was also a leading cause of death in children, especially aged one to four years. Most drowning deaths were due to falling into ditches and ponds. It is not surprising, because by that age children start exploring their surroundings and they come into contact with a potentially dangerous environment without having acquired appropriate knowledge and skills. These accidents also often happened whilst in the care of adults who were working in unsafe environments such as unfenced ponds and lakes.

Falling was more frequent in elderly; while traffic accidents mainly affected young males. Intentional injury was reported in nine cases, in which five were related to conflict among males, and four were admitted to be due to suicide. This seems to be a low proportion, but in rural areas of a developing country like Vietnam, intentional injury has not been a common problem [97, 98].

The number of deaths differed by sex, 657 deaths (53.9%) among males and 563 cases (46.1%) among females. “Old age” was identified as the cause of death in the pilot study, but then was grouped under unknown causes in the final data set. For these cases, it was difficult to determine specific CoDs because none had any specific signs or symptoms and so they could only be considered as ill defined conditions associated with old age. For the mortality pattern of FilaBavi, “old age” was ranked fifth, following cardiovascular diseases, infectious diseases, accidents and malignant neoplasms, but the number of people who died over of the age 70 was high, (655 cases or 53.7%) and the population over 70 years old is also high, accounting for 9.6 % of the total (males 3.3 % and females 6.3 %).

Infant mortality rate (IMR) for FilaBavi was calculated as 19.3 per 1,000 live births, while Bavi district overall (the district where FilaBavi is situated) quoted 19 per 1,000 live births (Source: Bavi Population and Family Planning Committee). For the whole country, the estimate was 26 per 1,000 live births in 2003 [94]. There were two cases of maternal death during the study period. The low IMR and almost no maternal mortality reflect the improvement in family planning services and childcare in this area.

4.3. Premature mortality: a public health concern

For all causes of death, YLL in FilaBavi in five-year period were 85/1,000 population and 55/1,000 population for males and females respectively. These figures were relatively lower than the WHO estimation for premature mortality in Vietnam in 2002, which presented 110.7 YLL/1,000 population for males and 84.7 YLL/1,000 population for females, for all causes of death [54]. The lower mortality experience in FilaBavi is not surprising as it is situated in the North Delta Region, which has been reported to have the lowest mortality rate in the country. In this study, the most common causes for small children were neonatal and perinatal causes, infectious diseases and accidents, while young adults suffered most from injuries (mostly accidental) and the older group were burdened by circulatory diseases, especially CVDs. Obviously, when comparing between YLL and crude mortality, the burden of premature mortality caused by perinatal causes, injuries, and malignant neoplasms exceeded their proportion of overall mortality (see Figure 8). Similar findings were reported from Slovenia where the leading causes of YLL were external causes, malignant neoplasms and CVDs [34]. However, in the setting, the leading causes of the mortality burden, both in terms of YLL and death counts, were CVDs, followed by malignant neoplasms.

The WHO estimates for Vietnam in 2002 indicated that the leading causes of YLL were perinatal conditions followed by ischaemic heart disease and stroke, while the leading causes of mortality were ischaemic heart disease, stroke, and chronic obstructive pulmonary disease [54]. Our estimates show a rather different pattern. First, UNICEF estimates a low infant mortality rate in Vietnam (20 per 1,000 live births in 2003), lower than in neighbouring countries such as Thailand, the Philippines, and Indonesia [99], despite their superior

economic performance. The WHO estimate is higher than that (26 per 1,000 live births in 2003) and hence gives a more prominent position to perinatal conditions in their ranking of YLL. Filabavi recorded 19.3/1000 live births as the IMR over the five-year period, lower than the UNICEF estimate. This may point in the direction of undercounting of infant deaths in the DSS although we are confident of capturing all deaths [64]. Second, stroke was a much greater cause of death in Filabavi than ischaemic heart disease while WHO estimates the reverse. Third, of the other causes and groups of conditions, pneumonia, road traffic accidents and cancers are responsible for a similar proportion of overall mortality but the WHO estimates for drowning are much lower and the WHO estimates for chronic obstructive pulmonary disease was much higher (see Table 3 - Paper II).

The mortality pattern in FilaBavi showed that infant deaths were most commonly related to low birth weight or short gestation, possibly consequent upon mothers' low nutritional status, resulting in high rates of birth asphyxia and congenital malformation. In Vietnam, the malnutrition rate for children under five was high, at 28% in 2002, reflecting concerns about food security in general [100]. These causes could be effectively prevented by improving antenatal care, nutritional status during pregnancy and the quality of maternal services. Not surprisingly, infant deaths contributed more than 10% of total YLL in this setting.

Ranked third in the burden of premature death were unintentional injuries, which accounted for 13.7% out of the total YLL. Data from the Vietnam Multi-Center Injury Survey (VMIS) showed that injury deaths accounted for the largest proportion of YPLL65 at 52% [101]. The leading sub-causes in our dataset were drowning for children from 4 to 15 years and traffic accidents and drowning for adolescents. Numbers were higher for boys than girls (23 cases and 14 cases respectively). Out of the total YLL from injuries, drowning alone accounted for nearly 60% while traffic-related accidents accounted for 16.2%. Nationally, injuries are becoming the biggest killer of children, accounting for 70% of mortality among under 20 year-olds, mainly from drowning [102]. For that age group, this now represents more than the total from all infectious diseases combined. The global situation showed a similar picture. One third of drowning globally occurred in the Western Pacific Region, which includes Vietnam,

where children under five years of age have the highest drowning mortality rate worldwide [103]. In this rural setting, the main exposures to childhood injuries were not associated with recreation or leisure but with everyday activities associated with a lack of supervision and unsafe environments such as rice farming.

Traffic-related accidents are an emerging public health problem in Vietnam and the most common cause of death for people of productive age, as in many other low-income countries in the global context [104]. They constantly ranked as the third leading cause of mortality in hospital in recent years [57, 60, 89, 91-95]. In FilaBavi, during rapid economic transition and urbanization, traffic accidents contributed the largest YLL, due to the death of young people at economically productive ages, especially males. Similar findings were also presented in Lam's study in Guangxi province, China [105].

4.4. Socio-economic situation inequality and mortality

In our study, lower educational and economic status groups experienced higher mortality rates than the better educated or richer for all three major categories of mortality. Education was a strongly protective determinant of mortality, even after allowing for age and economic status, suggesting the possibility that education may lead to positive lifestyle decisions. Women's education is often considered to be an important long-term health determinant, since women play a very important role in taking care of their family and especially their offspring [106]. However, because of the small proportion of women with higher education, this was difficult to investigate further. However, despite women's educational disadvantages, their survival was still greater overall compared with men, presumably reflecting their strong biological advantage.

Our results show that CVD mortality rates were significantly higher for men than women and the differences in mortality by gender were larger for CVD than for other NCD causes. The excess risk of dying from CVD in men was also stated by the American Heart Association [107] and can be explained by the differences in risk factor profiles between men and women. In fact, in our setting, men smoked more and had a higher prevalence of elevated blood

pressure [108]. In this study, age was proven to be more strongly associated with CVD mortality than for other NCD causes.

We found that CVD mortality rates decreased considerably among educated people as compared with those without formal education, even after adjusting for other independent variables such as gender, age and economic status. This is similar to the findings of a number of studies that showed an inverse socio-economic gradient for CVD mortality in developed [109-112] and developing countries [113].

Likewise, education was an important factor for health, particularly in the rural areas because education is usually associated with increased knowledge about health matters and consequent reduction in risky health behaviours, etc. Explanations suggested for observed educational differentials in CVD mortality include differentials in risk factors such as blood pressure, blood cholesterol, smoking, and obesity. Indeed, available evidence from other studies in Bavi support the observation that people with lower educational level smoked more and had more hypertension [108]. In this study, CVD mortality was found to have a stronger association with education than other NCD mortality in both genders. This is similar to findings from studies in England [114], Israel [115], and Korea [116]. Economic status was found not to be significantly associated with CVD mortality in a multivariate regression model. This showed a possibly rising burden of CVD mortality among the poor which demonstrates the shift from "early to later adopter" of a CVD epidemic.

Born and dying here, people always wish to stay forever in their motherland

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS

In the context of economic and epidemiological transition in Vietnam, patterns of morbidity and mortality have been changing, which places on the country a double burden of disease, with both emerging NCD and unfinished and recurrent patterns of communicable diseases. This is clear despite little being known about the true picture of diseases and mortality patterns in the country, due to a lack of community-based data. This study has provided a possible approach for understanding cause of death at the community level as well as its distribution and associations with socio-economic situations.

While more work is needed in validating the VA approach, this study suggests that VA is an appropriate and useful method for ascertaining cause of death in a community in rural Vietnam where specific data are otherwise scarce. The study illustrates the fact that the combination of VA methods in a longitudinal DSS can provide useful information to characterise unavailable mortality patterns in a community, and has potential as a resource for health planning. There is potential for the country to establish a national representative sample of vital registration system using VA to acquire reliable mortality data on the basis of experience gained from this study.

The causes of death in FilaBavi reflect a pattern typical of that in developing countries which are in epidemiological transition. Results of this study showed the overall leading causes of death were CVD, malignant neoplasms and infectious diseases. Accidents and their adverse effects also contributed a large part of mortality, with the leading type of accident being drowning in small children and traffic-related accidents in young men. National health policies and intervention strategies need to tackle both NCD and communicable diseases at the same time, which remains a challenge.

In terms of premature mortality, CVD, malignant neoplasms, and external causes were also leading causes. However, when comparing YLL and crude mortality, the burden of premature mortality due to perinatal causes, injuries, and malignant neoplasms exceeded their proportion of overall mortality. Using the YLL approach for quantifying the burden of premature deaths

can assist in setting priorities for interventions against deaths from specific causes, depending on patterns of future life at risk. If one of the important goals of public heath is to prevent premature death, using the YLL index will provide a focus on social and economic losses resulting from deaths before their "natural" time, which is more helpful than merely describing the occurrence of death itself.

We also showed that lower educational and economic status groups experienced higher mortality rates than the better educated or better off for all three major mortality categories, NCD, communicable diseases, and injuries. There is also a possibility of rising burden of CVD mortality among disadvantaged groups, which seems correspond with the early stages of the so-called "shift from early to later adopter" of a CVD epidemic. Attention should be paid to improving education levels as one important determinant of health, along with economic development. There is also an urgent need to develop and implement effective policies and interventions against CVD, as one of the leading causes of death in this setting as well as in the country.

This study is an initial effort to provide information on community-based mortality patterns, using a longitudinal follow-up study of a dynamic cohort. Continuing the study using VA approach as part of a routine data collection procedure in the setting will help to understand the trend in mortality patterns in the community over time, which may be useful for priority setting and health planning purposes, not only at the local but also at the national level.

However, further analyses are needed to understand mortality inequality across all ages to have a comprehensive picture of the mortality burden in the setting. Validation studies and standardisation of VA methods should be carried out whenever possible to improve the performance and utility of this approach.

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