Perceptions and Practices of Cardiovascular Health

A population perspective from a peri-urban Nepalese community

Abhinav Vaidya

Institute of Medicine at Sahlgrenska Academy University of Gothenburg
PERCEPTIONS AND PRACTICES OF CARDIOVASCULAR HEALTH:
A population perspective from a peri-urban Nepalese community

Abhinav Vaidya
Institute of Medicine
Sahlgrenska Academy at University of Gothenburg

UNIVERSITY OF GOTHENBURG
Göteborg, Sweden
2014
A doctoral thesis at a university in Sweden is produced either as a monograph or as a collection of papers. In the latter case, the introductory part constitutes the formal thesis, which summarizes the accompanying papers. These have either been published or are manuscripts at various stages (in press, submitted, or in manuscript).

Abhinav Vaidya  
Department of Internal Medicine and Clinical Nutrition, Institute of Medicine, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden

abhinav.vaidya@gu.se

Authors hold the rights to the published articles


Printed at Ale Tryckteam AB, Bohus, Sweden
This work is dedicated to those who are doing
their bit to preserve and promote cardiovascular health
and prevent cardiovascular diseases.
ABSTRACT

Background
Global phenomena such as urbanization and individual traits such as health literacy affect people’s exposure and vulnerability to cardiovascular risk factors. Nepal, a low-income South Asian country undergoing epidemiological transition, has limited data and understanding of cardiovascular health issues, particularly regarding cardiovascular health literacy, perception and practice on the community level.

Aims
This Thesis investigated issues of cardiovascular health from a population perspective. Specifically, it first aimed to establish a Health Demographic Surveillance Site in a peri-urban Nepalese setting; then, assess knowledge, attitude, and practice (KAP)/behavior regarding cardiovascular risk factors, manifestations, and preventability; understand behavioral and life-style risk factors such as physical activity and diet in terms of their sociodemographic correlates; and finally, explore the perceptions of cardiovascular health and disease among those already affected.

Methods
A health demographic surveillance site was established in Jhaukhel and Duwakot, two peri-urban villages near Kathmandu. A mixed methods research approach was then used. Quantitative studies assessed cardiovascular health literacy, knowledge and attitude in a sample population. Cardiovascular health behaviour, particularly physical inactivity and fruit and vegetable consumption, were studied. Additionally, a qualitative study to explore perceptions and experiences of patients with cardiometabolic diseases was conducted.

Results
Forty four percent of the study population had poor knowledge of cardiovascular health. Moreover, only 14.7% and 13.9% of respondents with highly satisfactory knowledge also had highly satisfactory attitude and practices, respectively. Behavioral cardiovascular risk factors were high (low physical activity: 43.3%, inadequate fruit and vegetable consumption: 97.9%) and varied by sociodemographic correlates. Furthermore, patients understood the importance of lifestyle modification only after diagnosis.

Conclusions
The studies presented in this Thesis demonstrate the current inadequacy of health literacy in Nepal. In addition, gaps exist between cardiovascular health knowledge, attitude, and practice/behavior, even among those already affected. The coupling of high behavioral risk burden with low cardiovascular health literacy implies need for multi-sector health promotional strategies in the country.

Keywords
Attitude, behavior, cardiovascular diseases, cardiovascular health, fruit and vegetable intake, health literacy, knowledge, practice, physical activity, urbanization
LIST OF PAPERS

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

Paper I
Aryal UR*, Vaidya A*, Shakya-Vaidya S, Petzold M, Krettek A. Establishing a health demographic surveillance site in Bhaktapur district, Nepal: initial experiences and findings. (*Equal contribution) 

Paper II
Vaidya A. Aryal UR, Krettek A. Cardiovascular health knowledge, attitude, and practice/behaviour in an urbanising community of Nepal: a population-based cross-sectional study from Jhaukhel-Duwakot Health Demographic Surveillance Site. 

Paper III
Vaidya A, Krettek A. Physical activity level and its sociodemographic correlates in a peri-urban Nepalese population: a cross-sectional study from the Jhaukhel-Duwakot health demographic surveillance site. 

Paper IV
Vaidya A, Oli N, Aryal UR, Karki DB, Krettek A. Disparities in fruit and vegetable intake by socio-demographic characteristics in peri-urban Nepalese adults: findings from the Heart-Health Associated Research and Dissemination in the Community (HARDIC) Study, Bhaktapur, Nepal. 

Paper V
Global Health Action 2014; 7:24023
Additionally, this Thesis incorporates the following articles published during the study period. They are attached as Appendix.


Additionally, this Thesis incorporates the following articles published during the study period. They are attached as Appendix.


**ABBREVIATIONS**

CVD    cardiovascular disease
GPAQ   Global Physical Activity Questionnaire
HARDIC Heart-Health Associated Research and Dissemination In the Community
HDSS   health-demographic surveillance site
KMC    Kathmandu Medical College
LPA    low physical activity
LMIC   low- and middle- income country
MDG    Millennium Development Goal
NCD    non-communicable disease
NMC    Nepal Medical College
RF/RHD rheumatic fever/rheumatic heart disease
TPA    total physical activity
VDC    village development committee
WHO    World Health Organization
I have been interested in the epidemiological and preventive aspects of cardiovascular disease since I graduated in medicine in 2000. Apart from the clinical work I did as a doctor, I had pursued cardiovascular research in various capacities since the beginning of my career. During 2002–2003, I participated as a research officer in the multicentric INTERHEART study. During my MD training, I was principal investigator of the first and only community-based prevalence study of coronary heart disease in Nepal. To pursue further training in cardiovascular epidemiology and prevention, I went to England in August 2008 to attend a 10-day teaching seminar that was organized by The International Society of Cardiovascular Disease Epidemiology and Prevention. Thirty participants from different Asian, African, European, and South American countries had gathered at Oxford. Among them was Alexandra Krettek, who would become my future supervisor. During one of those 10 days, I was chatting with Alexandra about Nepal and what both of us were doing. I discovered that her institute, the Nordic School of Public Health NHV, had shown some interest in Nepal in the past but somehow the collaboration process had remained incomplete. On the other hand, I was seeking an opportunity to pursue cardiovascular health issues. Soon our discussion turned out to be productive for both of us. On the last evening of the seminar, Alexandra and I bade each other goodbye and said we would stay in touch about our common interest. Six months later, I was a PhD student at the Nordic School of Public Health NHV.

That was the beginning of my journey into the PhD world, a journey that began with mixed feelings of enthusiasm, confusion, and uncertainty. A detour quickly appeared in the form of a major change in the research plan. Instead of plunging directly into my area of work in cardiovascular health, financial...
circumstance required me to first establish a health demographic surveillance site in the study area. At the time, it felt like an unnecessary deviation, but the establishment of a surveillance site turned out to be a blessing in disguise because it would provide us with detailed otherwise unavailable social and health-related information about the population of the study site.

However, the major blow was yet to come. During the penultimate year of my planned PhD defense, the Nordic Council of Ministers decided unexpectedly to close the Nordic School of Public Health NHV by the end of 2014. Weeks of despair and desperation followed. Attempts to acquire academic asylum at the University of Gothenburg became a long administrative struggle that was gallantly spearheaded by my supervisor, Alexandra. Finally, an auspicious morning in August 2013 brought the good news that the University of Gothenburg had officially confirmed my acceptance into its PhD program. The storm was over. It was time for some science again!

Speaking of science, the most fulfilling part of my PhD has been the opportunity to work on cardiovascular health in the community. Indeed, my area of work not only fulfills my personal interest, but also answers an urgent need in Nepal. I am happy that I have been able to contribute something toward that effort. However, much work remains, and this is just the beginning of my journey.
# TABLE OF CONTENTS

**BACKGROUND** .................................................................................................................................................. 1
- Cardiovascular diseases: a growing epidemic of non-communicable disease .............................................. 1
- Epidemiological transition: a contributing factor to the cardiovascular disease epidemic ............................. 1
- Behavioral risk factors underlie the non-communicable disease epidemic ............................................... 2
- Increased physical inactivity as a reflection of changing lifestyle ..................................................................... 3
- Inadequate intake of fruit and vegetables ........................................................................................................ 4
- Health literacy as a factor influencing cardiovascular health behavior ....................................................... 4
- Nepal: a country with geo-ethnic diversity ..................................................................................................... 5
- Sociodemographic transition in Nepal ........................................................................................................... 5
- Healthcare system of Nepal ........................................................................................................................ 6
- Burden of cardiovascular disease and its risk factors in Nepal ..................................................................... 6
- Current focus of cardiovascular disease prevention and control strategies in Nepal .................................... 9
- Cardiovascular health literacy/health knowledge research in Nepal ............................................................ 10
- Health demographic surveillance site as a setting for studies on non-communicable diseases .......................................................... 10

**RESEARCH AIMS** ........................................................................................................................................... 12

**THEORETICAL FRAMEWORK** ..................................................................................................................... 13

**CONCEPTUAL FRAMEWORK** ...................................................................................................................... 15

**METHODOLOGICAL CONSIDERATIONS** .................................................................................................... 16
- Study site and population ............................................................................................................................. 16
- Research design ........................................................................................................................................... 18
- Sampling ....................................................................................................................................................... 18
- Data collection ............................................................................................................................................ 23
- Tools and definitions .................................................................................................................................. 23
- Data management ....................................................................................................................................... 28
- Data analysis ............................................................................................................................................... 29
- Ethical considerations ................................................................................................................................. 35

---

**FUTURE PERSPECTIVES** .............................................................................................................................. 70

**CONCLUSIONS** ............................................................................................................................................. 68

**DISCUSSION** .................................................................................................................................................. 55

---

**APPENDIX**

**PAPERS I-V**

**REFERENCES** ................................................................................................................................................ 76

**ACKNOWLEDGMENTS** ................................................................................................................................ 71

**RESULTS** ...................................................................................................................................................... 37

- Relevance of the study findings to other low- and middle-income countries .................................................. 67
- Implications for health policy in Nepal ......................................................................................................... 65
- Learning points for cardiovascular health promotion in Nepal ..................................................................... 60
- Epidemiological perspectives ....................................................................................................................... 55
- Urban Nepalese community ........................................................................................................................... 52
- Among people with cardiometabolic conditions: findings of in-depth interviews from a peri-urban community of Nepal: findings from the Heart-Health associated Research and Dissemination in the Community (HARDIC) Study, Bhaktapur, Nepal ................................................................. 51
- Paper V: Experiences and perceptions about cause and prevention of cardiovascular disease research in Nepal .......................................................... 51
- Paper IV: Disparities in fruit and vegetable intake by sociodemographic characteristics in the Nepal population: a cross-sectional study from the Jhaukhel-Duwakot health demographic surveillance site. ......................................................................................................................... 47
- Paper III: Physical activity level and its sociodemographic correlates in a peri-urban community of Nepal: a population-based cross-sectional study from Jhaukhel-Duwakot Health Demographic Surveillance Site, Nepal ......................... 47
- Paper II: Cardiovascular health knowledge, attitude, and practice/behaviour in an urbanizing community of Nepal: a population-based cross-sectional study from Jhaukhel-Duwakot Health Demographic Surveillance Site, Nepal .......... 47
- Paper I: Establishing a health demographic surveillance site in Bhaktapur district, Nepal: initial experiences and findings .............................................................................................................................. 37
RESULTS........................................................................................................................................37

Paper I: Establishing a health demographic surveillance site in Bhaktapur district, Nepal: initial experiences and findings ..............................................................................................................37

Paper II: Cardiovascular health knowledge, attitude, and practice/behaviour in an urbanizing community of Nepal: a population-based cross-sectional study from Jhaukhel-Duwakot health demographic surveillance site ......................................................................................................................39

Paper III: Physical activity level and its sociodemographic correlates in a peri-urban Nepalese population: a cross-sectional study from the Jhaukhel-Duwakot health demographic surveillance site ..........................................................................................................................47

Paper IV: Disparities in fruit and vegetable intake by socio-demographic characteristics in peri-urban Nepalese adults: findings from the Heart-Health Associated Research and Dissemination in the Community (HARDIC) Study, Bhaktapur, Nepal .........................................................................................................................51

Paper V: Experiences and perceptions about cause and prevention of cardiovascular disease among people with cardiometabolic conditions: findings of in-depth interviews from a peri-urban Nepalese community ..........................................................................................................................52

DISCUSSION ....................................................................................................................................55

Epidemiological perspectives ..................................................................................................................55

Learning points for cardiovascular health promotion in Nepal ..................................................................60

Implications for health policy in Nepal ....................................................................................................65

Relevance of the study findings to other low- and middle-income countries ........................................67

CONCLUSIONS .....................................................................................................................................68

FUTURE PERSPECTIVES .....................................................................................................................70

ACKNOWLEDGMENTS .........................................................................................................................71

REFERENCES .........................................................................................................................................76

PAPERS I-V

APPENDIX
Cardiovascular diseases: a growing epidemic of non-communicable disease

Non-communicable, or chronic, diseases (NCDs) have long duration and generally progress slowly (1). Based on disease burden, cardiovascular disease (CVD), cancer, chronic respiratory disease, and diabetes mellitus comprise the four main NCDs (1). Other NCDs include mental disease, sensory disorders such as blindness and hearing loss, digestive disorders such as liver cirrhosis, and musculo-skeletal diseases such as arthritis (2). NCDs are the major causes of adult mortality and morbidity (3). In 2010, NCDs killed 34.5 million people worldwide (i.e., two thirds of 52.8 million deaths) (3). Projections suggest that the impact of NCDs will continue to rise worldwide, particularly in low- and middle-income countries (LMICs) where 80% of NCD deaths currently occur (4).

CVDs, which represent the single largest cause of death worldwide, include a group of diseases that involve the heart, blood vessels, or the sequelae of poor blood supply resulting from diseased vascular supply (2). Globally, CVDs account for 30% of all deaths and 50% of NCD deaths (4). Among CVDs, the leading cause of death is ischemic heart disease (IHD) (4).

Epidemiological transition: a contributing factor to the cardiovascular disease epidemic

In developed countries, NCDs, particularly CVDs, were once termed diseases of the rich (5). However, over the past two decades CVD deaths have declined in high-income countries and significantly increased in LMICs (6). One reason for this increase is epidemiological transition such as that currently occurring in the South Asia region (7).

Epidemiological transition refers to a shift from the predominance of infectious diseases and nutritional disorders toward degenerative or chronic
BACKGROUND

Cardiovascular diseases: a growing epidemic of non-communicable disease
Non-communicable, or chronic, diseases (NCDs) have long duration and generally progress slowly (1). Based on disease burden, cardiovascular disease (CVD), cancer, chronic respiratory disease, and diabetes mellitus comprise the four main NCDs (1). Other NCDs include mental disease, sensory disorders such as blindness and hearing loss, digestive disorders such as liver cirrhosis, and musculo-skeletal diseases such as arthritis (2). NCDs are the major causes of adult mortality and morbidity (3). In 2010, NCDs killed 34.5 million people worldwide (i.e., two thirds of 52.8 million deaths) (3). Projections suggest that the impact of NCDs will continue to rise worldwide, particularly in low- and middle-income countries (LMICs) where 80% of NCD deaths currently occur (4).

CVDs, which represent the single largest cause of death worldwide, include a group of diseases that involve the heart, blood vessels, or the sequelae of poor blood supply resulting from diseased vascular supply (2). Globally, CVDs account for 30% of all deaths and 50% of NCD deaths (4). Among CVDs, the leading cause of death is ischemic heart disease (IHD) (4).

Epidemiological transition: a contributing factor to the cardiovascular disease epidemic
In developed countries, NCDs, particularly CVDs, were once termed diseases of the rich (5). However, over the past two decades CVD deaths have declined in high-income countries and significantly increased in LMICs (6). One reason for this increase is epidemiological transition such as that currently occurring in the South Asia region (7).

Epidemiological transition refers to a shift from the predominance of infectious diseases and nutritional disorders toward degenerative or chronic
diseases (8). Five stages of epidemiological transition have been described (9). Every country, or different regions within a country, is in one stage or another (9). As countries move through the stages, NCDs dominate communicable, nutritional, and maternal causes of diseases. Drivers of transition include industrialization and urbanization. Urbanization, which involves the transition from rural to more urban society, currently occurs mainly in LMICs in Asia and Africa. In the next two decades, LMICs will comprise more than 80% of the world’s urban population (10). The increasing trend toward urbanization presents large health challenges, including pollution, communicable diseases, and NCDs (11). The urbanization process precipitates lifestyle-related risk factors such as increased prevalence of sedentary habits and higher consumption of calories and fat (12). Changing dietary habits and reduced physical mobility can shift a society’s disease pattern from previously predominant infectious and communicable diseases toward a double disease burden and increased prevalence of NCDs, including CVDs (13). For this reason, NCDs have been called diseases of urbanization. Indeed, risk factors of NCDs are found more commonly among urban communities compared to rural communities in LMICs (14).

**Behavioral risk factors underlie the non-communicable disease epidemic**

Risk factors that underlie most NCDs, including CVDs, are largely preventable and stem from behaviors such as tobacco consumption, harmful use of alcohol, inadequate physical activity, and unhealthy diet (4). Eliminating these common risk factors could prevent up to 80% of heart disease, stroke, and type 2 diabetes and over one third of cancers (15). Recently, the prevalence of such behavioral risk factors has accelerated due to the impact of global drivers such as globalization and urbanization (11).
Increased physical inactivity as a reflection of changing lifestyle

Reflecting the growing impact of globalization and urbanization, almost one third of the world’s population now exhibits physical inactivity (4). Low physical activity (LPA) is the fourth leading cause of mortality worldwide and accounts for 6% of CHD and 7% of type 2 diabetes mellitus (16). Following recognition as an independent risk factor in the 1990s (17), physical inactivity received global attention with the Global Strategy on Diet, Physical Activity and Health of the World Health Organization (WHO) (15). Since then, epidemiological studies on physical inactivity have evolved in various aspects. First, researchers are increasingly using pedometers and other devices to conduct objective assessments. However, despite improved accuracy, such devices are difficult and impractical to use in many settings, particularly in low-income countries (18). On the other hand, subjective assessments based on questionnaires and recall methods, such as the International Physical Activity Questionnaire (IPAQ) and Global Physical Activity Questionnaire (GPAQ), remain the only way to measure physical activity in settings with limited resources despite a high level of recall and other biases (19).

Second, there have been recent attempts to study the determinants and correlates of physical inactivity, many of which are demographic, psychosocial, behavioral, and environmental in origin (20). Such determinants include urbanization and its impact, especially regarding more sedentary behavior and the increased use of automated vehicles. Third, different domains of physical activity in everyday life (i.e., work, household, travel, and leisure) are gaining increased interest, particularly regarding their associations with cardiovascular health (21). Fourth, scientists now advocate physical activity in the form of “exercise on prescription” for the prevention and treatment of cardiometabolic diseases (22).
**Inadequate intake of fruit and vegetables**

Low intake of fruits and vegetables accounts for 11% of IHD (4). WHO recommends a daily minimum of five servings (400g) of fruits and vegetables (23). Underscoring the importance and health potential of fruits and vegetables, increased intake (up to 600g) could reduce the burden of IHD and ischemic stroke by 31% and 19%, respectively (24). In the context of WHO’s recommendation, fruit and vegetable intake varies extensively worldwide. (25).

**Health literacy as a factor influencing cardiovascular health behavior**

Health literacy, which is a key concept for health promotion and health education, was used originally in the United States to describe a patient’s decision-making ability, compliance with prescription medication, and capacity to self-manage chronic diseases (26). From this narrow healthcare perspective, health literacy has evolved to a much broader interpretation that defines public health literacy as an outcome of health education and health promotion (27, 28). Another dimension of health literacy focuses mainly on the link between health and education (29). Although these different perspectives have spawned many definitions of health literacy, this Thesis uses the WHO-endorsed definition, which states that health literacy implies “cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand, and use information in ways which promote and maintain good health” (30).

Limited health literacy associates with increased occurrence and poor management of NCDs (31) as well as poor knowledge of the disease condition (32). Evidence on the effectiveness of interventions to improve health literacy has been limited, variable, and mixed. For example, interventions in Canada and the United States that aimed only at cardiovascular knowledge through health education did not yield better health behavior (33, 34). Although scarce in LMICs, research on health literacy is definitely needed due to the growing epidemic of CVDs in countries with limited resources (35).
Nepal: a country with geo-ethnic diversity
Nepal, a federal democratic republic with approximately 26.6 million inhabitants, is a landlocked low-income country in South Asia, located between China and India. Its geography, culture, and religions are highly diverse and rich. Nepal comprises three distinct geographical areas: the southern plain belt, called terai; the middle hills and valleys, including the capital region of Kathmandu, Bhaktapur, and Lalitpur; and the northern Himalayan Mountains.

For administrative purposes, Nepal is divided into five developmental regions, from east to west. The country consists of 14 zones and 75 districts. Each district contains mostly rural areas (i.e., village development committees [VDCs]) and several townships, or municipalities. According to the 2011 census, Nepal has 125 castes and ethnic groups and 123 different languages and dialects (36). The largest caste/ethnic group is Chhetri, followed by Brahmin, Magar, Tharu, Tamang, Newar, Kami, Musalman, Yadav, and Rai. Broadly, the different ethnic groups derive from two main ethno-origins: Tibeto-Burman and Indo-Aryan (37). The people of the Tibeto-Burman group originated through large-scale migrations of Mongoloid groups from Tibet and include ethnic groups such as Tamang, Rai, Limbu, Sherpa, and Newar. Indo-Aryan people hail from northern India and participated in the early settlement of Nepal. They include the Brahmins and the Chhetris, the people of the terai, and the Tharus. The Tibeto-Burman group has a higher prevalence of hypertension compared to the Indo-Aryan group (25.3% vs. 14.0%) (38).

Sociodemographic transition in Nepal
Nepal is currently experiencing significant lifestyle changes that spring from various social and demographic changes. This epidemiological transition includes urbanization and migration. High unemployment and underemployment force people to choose between remaining in a vicious circle of poverty or migrating to seek better livelihood opportunities both within and outside Nepal.
According to the 2011 national census, about 17% of the total Nepalese population lives in urban areas (36). Most of the urban population is concentrated in Kathmandu, Nepal’s capital city.

**Healthcare system of Nepal**

Like many other nations, Nepal’s public health system is based on the principles of primary health care and deals mostly with infectious diseases and maternal and child health. Although Nepal is on track to achieve the Millennium Development Goals (MDGs) for maternal and child health, its infant and maternal mortality rates are still high (46 per 1,000 live births and 281 per 1,00,000 live births respectively) (39).

Nepal’s healthcare system is both public (governmental) and private. In the governmental health system, the Ministry of Health and Population occupies the central position (40), and decentralization occurs at each level of the hierarchical organogram. The five Regional Health Directorates are responsible for health in each of the five regions, and District Public Health Offices/District Health Offices monitor each of the 75 districts. Successively smaller geographical areas are served by primary health care centers, health posts, and sub-health posts (41). Although workers in the public health system are spread throughout the country, including rural areas, those who work in the private sector, especially doctors, mostly cluster in urban areas.

**Burden of cardiovascular disease and its risk factors in Nepal**

CVDs are a major public health issue in Nepal and now account, along with other major NCDs, for 60% of the disease burden (42). Nepal displays an abundance of harmful risk factors that lead to CVDs and lacks a system to maintain cardiovascular health (Figure 1) (43, 44). Major reasons for such weak preparedness to tackle NCDs include the concomitant challenges of poverty,
According to the 2011 national census, about 17% of the total Nepalese population lives in urban areas. Most of the urban population is concentrated in Kathmandu, Nepal’s capital city.

Healthcare system of Nepal
Like many other nations, Nepal’s public health system is based on the principles of primary health care and deals mostly with infectious diseases and maternal and child health. Although Nepal is on track to achieve the Millennium Development Goals (MDGs) for maternal and child health, its infant and maternal mortality rates are still high (4 per 1,000 live births and 28 per 1,000 live births respectively).

Nepal’s healthcare system is both public (governmental) and private. In the governmental health system, the Ministry of Health and Population occupies the central position, and decentralization occurs at each level of the hierarchical organogram. The five Regional Health Directorates are responsible for health in each of the five regions, and District Public Health Offices/District Health Offices monitor each of the 75 districts. Successively smaller geographical areas are served by primary health care centers, health posts, and sub-health posts. Although workers in the public health system are spread throughout the country, including rural areas, those who work in the private sector, especially doctors, mostly cluster in urban areas.

Burden of cardiovascular disease and its risk factors in Nepal
CVDs are a major public health issue in Nepal and now account, along with other major NCDs, for 60% of the disease burden. Nepal displays an abundance of harmful risk factors that lead to CVDs and lacks a system to maintain cardiovascular health. Major reasons for such weak preparedness to tackle NCDs include the concomitant challenges of poverty, communicable diseases, high maternal deaths, malnutrition, and the lack of a competent healthcare system.

Figure 1: Overview of risk factors for atherosclerotic cardiovascular diseases in the context of Nepal, and major hindrances at different levels of prevention [Figure adapted from 43]. Numbers in parentheses are approximates for Nepal, based on different national and sub-national studies done in 2003–2007.
The actual burden and trend of CVDs in Nepal is unknown. However, data from various sources indicate that the problem is common and could be increasing (43). Common cardiovascular problems include hypertension, coronary artery disease, stroke, rheumatic fever/rheumatic heart disease (RF/RHD), congenital heart disease, and congestive heart failure (43). Prevalence of hypertension affects 20%–33% of the adult population (44–48), and coronary heart disease affects around 6% of adults in urban areas (49). RF/RHD is common in Nepal: approximately 1–2 per 1,000 school-age children suffer from this disease (50, 51). Congenital heart diseases account for most cardiac surgeries in the National Heart Center in Kathmandu (52).

WHO recognizes four major modifiable behavioral risk factors for CVDs: tobacco use, unhealthy diet, insufficient physical activity, and harmful use of alcohol. All four are prevalent in Nepal (44). These risk factors lead to four major metabolic conditions: overweight/obesity, high blood pressure, elevated blood sugar, and elevated lipids. In turn, these conditions cause increased incidence of coronary artery disease, stroke, congestive heart failure, and chronic kidney disease.

Although data in Nepal has been inconsistent, physical inactivity ranges from moderate (18%) to a staggering 92% (20). Once an agro-based country, Nepal is in the midst of an epidemiological transition, and a majority of its people now lives an urban or urbanizing lifestyle. Therefore, this Thesis measures physical inactivity to show how ongoing urbanization affects the Nepalese community, and studies the possible sociodemographic variations within the population. Importantly, information on such variations helps to tailor future interventions to improve physical activity in the population.

In Nepal, fruit and vegetable intake is consistently low. For example, the 2007–2008 WHO-STEPS Non-Communicable Diseases Risk Factors Survey showed that both men and women do not consume the recommended amount of fruit and vegetables (60.5% and 63.5%, respectively) (25). Therefore, this Thesis
explored possible sociodemographic disparities in fruit and vegetable intake within a community. Apart from the national NCD survey that studied this risk factor gender-wise (44), no previous study in Nepal has investigated the relationship between fruit and vegetable intake and sociodemographic factors such as educational level and occupation.

**Current focus of cardiovascular disease prevention and control strategies in Nepal**

In tackling CVDs, the Government of Nepal mainly invests in strengthening therapeutic services (e.g., establishing tertiary care centers) and providing financial assistance for the treatment of poor patients. Although this approach is important and should be continued, preventive services still lack adequate attention (53). Even therapeutic services are very limited and available only in urban areas. Privately operated hospitals provide most treatment services in Nepal’s major cities.

The availability of interventional cardiology and cardiothoracic surgery services increased dramatically in the last decade. Among about 80 registered cardiologists in Nepal, 90% are located in Kathmandu. However, most of the country consists of villages. Health care in these often remote areas is provided mainly by auxiliary health manpower (about 7,000) and community health volunteers (about 50,000) who are neither trained nor expected to manage CVD in the primary healthcare services that they provide.

Regarding health promotional activities, Nepal has at least a dozen patient-centric societies, clubs, associations, and volunteer groups that operate different awareness and screening programs for both patients and the general public. Although their motives are noble, inadequate networking, manpower, and funding limit their outreach to urban areas and to the observation of special days (e.g., World Heart Day) (53).
On the policy front, recent national and international attention on CVD resulted in formulation of a NCD policy draft, but it has not yet gained government endorsement (54). However, the ongoing global effort to include NCDs in the MDG agenda has stirred renewed interest among the stakeholders.

**Cardiovascular health literacy/health knowledge research in Nepal**

Public health literacy regarding underlying risk factors and symptoms of heart disease or possible ways to prevent them is an important issue in tackling CVDs (32, 55, 56). Studies in Nepal report low knowledge about heart attack symptoms in the general population and about diabetes even among diabetes patients (57, 58). Our pilot study in Duwakot Village in the Bhaktapur district also shows lack of understanding and inability to apply knowledge (13). Hence, this Thesis aimed to further explore the concept of cardiovascular health literacy in the Nepalese context.

**Health demographic surveillance site as a setting for studies on non-communicable diseases**

There are many sources of health information in Nepal including the Health Management Information System, which pools data from the grass roots to the central level and publishes it in an annual report (59). However, Nepal currently lacks a mechanism that regularly generates relevant information on CVDs. The WHO-STEPS Non-Communicable Disease Risk Factors Survey, which was conducted nationwide for the first time in 2007, focuses mainly on risk factors (44). On the other hand, population-based surveys such as the National Health Demographic Surveys, which collect health information every 5 years, do not include CVD-related questions. At the community level, these surveys are too widely spaced and often do not cover the same population. Therefore, most available CVD data comes from two sources: (i) sporadic and often one-time cross-sectional studies, and (ii) publications based on hospital records that
inherently cannot represent the whole population. Further, hospital data are usually incomplete, not maintained digitally, and lack a system that can pool data from different hospitals. Thus, there is a gap in the information system for regularly providing population-based data on CVDs. Health and demographic surveillance systems (HDSS) somewhat fill that gap.

A HDSS is a longitudinal, population-based health and vital registration system that monitors demographic (e.g., birth, deaths, and migration) and health (e.g., clinical attendance and hospital admissions) events in a geographically defined population and also produces timely data (60). Moreover, HDSSs can be used as a surveillance system to monitor disease trends over time. They also serve as a platform for evaluating specific interventions (61). However, the concept of HDSS is not entirely free of criticism. For example, a debate favoring investment in the vital registration system rather than HDSS as a source of data has recently ensued. The basis of the argument is that HDSSs are usually small in size and not representative beyond a certain socio-geographic locale (62). Nonetheless, recent studies demonstrate that HDSS data can be nationally representative (63).

HDSSs are especially important where the quality and accessibility of health services are poor and recording systems are poorly developed (64). To study NCDs in Nepal, HDSSs become even more important because information on NCDs is not available through routine sources. Indeed, HDSSs have been used as an epidemiological resource to study clusters of NCD risk factors in other countries (65).
RESEARCH AIMS

The overall aim of this Thesis is to understand cardiovascular health issues from a population perspective, especially in terms of perceptions about cardiovascular risk factors, cardiovascular disease manifestation, and preventability. Further, this Thesis focuses on behavioral and life-style related risk factors, mainly diet and physical activity, and intends to provide a foundation for future cardiovascular health promotional interventions in Nepal.

Specifically, I wanted to

- establish an HDSS in Bhaktapur, Nepal, to conduct specific studies on cardiovascular health (Paper I);
- assess knowledge, attitude, and practice (KAP)/behavior regarding cardiovascular risk factors, manifestations, and preventability of cardiovascular disease among the general population (Paper II);
- understand behavioral and life-style risk factors such as physical activity (Paper III) and diet (Paper IV) in terms of their sociodemographic correlates, particularly in the context of urbanization; and
- explore perception and practice of cardiovascular health and disease among those already affected (Paper V).

THEORETICAL FRAMEWORK

The central theme of this Thesis is studying cardiovascular health behavior in Nepal through the lens of health literacy. The Thesis incorporates constructs of three different health behavior theories to explain the cardiovascular health behavior of the study population and, in combination, help to identify the potential foci of intervention (Figure 2, next page).

Health belief model

The health belief model (HBM) explains health behavior through better understanding of individuals' health beliefs (66). HBM explains whether they perceive themselves at risk, if they think there will be serious consequences if they develop disease, whether they believe that there are ways to reduce their susceptibility, and if the benefits of actions outweigh costs and barriers (67).

Social cognitive theory

Social cognitive theory (SCT) proposes that behavior can be explained in terms of triadic reciprocity between three key concepts that operate as determinants of each other: the person, the environment, and the behavior (68). SCT has been widely applied to health behavior with respect to prevention and health promotion (66).

Theory of reasoned action

The theory of reasoned action (TRA) assumes that intention to act is the most immediate determinant of behavior and that all other factors that influence behavior will do so through behavioral intention (66). In TRA, intentions are grounded in values and expectations (69). Intentions are also affected by subjective norms (i.e., a person's beliefs about what other people think he/she should do) (67).
THEORETICAL FRAMEWORK

The central theme of this Thesis is studying cardiovascular health behavior in Nepal through the lens of health literacy. The Thesis incorporates constructs of three different health behavior theories to explain the cardiovascular health behavior of the study population and, in combination, help to identify the potential foci of intervention (Figure 2, next page).

Health belief model
The health belief model (HBM) explains health behavior through better understanding of individuals’ health beliefs (66). HBM explains whether they perceive themselves at risk, if they think there will be serious consequences if they develop disease, whether they believe that there are ways to reduce their susceptibility, and if the benefits of actions outweigh costs and barriers (67).

Social cognitive theory
Social cognitive theory (SCT) proposes that behavior can be explained in terms of triadic reciprocity between three key concepts that operate as determinants of each other: the person, the environment, and the behavior (68). SCT has been widely applied to health behavior with respect to prevention and health promotion (66).

Theory of reasoned action
The theory of reasoned action (TRA) assumes that intention to act is the most immediate determinant of behavior and that all other factors that influence behavior will do so through behavioral intention (66). In TRA, intentions are grounded in values and expectations (69). Intentions are also affected by subjective norms (i.e., a person’s beliefs about what other people think he/she should do) (67).
The central concept of this Thesis is health literacy and practice regarding cardiovascular health and diseases (Figure 3). This Thesis discusses KAP/behavior regarding cardiovascular health in an urbanizing Nepalese society by first establishing an HDSS in the study area. In particular, I have studied two behavioral risk factors (i.e., physical activity and fruit and vegetable consumption) in the context of urbanization and other sociodemographic correlates. Visualizing the cardiovascular health issues through the lens of health literacy, this Thesis further explores the perception and experience of individuals who already have cardiometabolic disease.

CVD, cardiovascular disease; HDSS, health demographic surveillance site

Figure 3: Conceptual framework of the Thesis and the areas of study covered by Papers I–V.

Figure 2: Constructs of health behavior models used in this Thesis.
CONCEPTUAL FRAMEWORK

The central concept of this Thesis is health literacy and practice regarding cardiovascular health and diseases (Figure 3). This Thesis discusses KAP/behavior regarding cardiovascular health in an urbanizing Nepalese society by first establishing an HDSS in the study area. In particular, I have studied two behavioral risk factors (i.e., physical activity and fruit and vegetable consumption) in the context of urbanization and other sociodemographic correlates. Visualizing the cardiovascular health issues through the lens of health literacy, this Thesis further explores the perception and experience of individuals who already have cardiometabolic disease.

Figure 3: Conceptual framework of the Thesis and the areas of study covered by Papers I–V.
METHODOLOGICAL CONSIDERATIONS

Study site and population
To monitor population-level demographic and health data, the Jhaukhel-Duwakot Health Demographic Surveillance site (JD-HDSS) was first established in the Jhaukhel and Duwakot villages in Bhaktapur district of Nepal, about 13 km from Kathmandu, the capital city (Figure 4).

Figure 4: Map of Nepal (insert) showing the Bhaktapur district and the location of the Health Demographic Surveillance Site (HDSS) in Duwakot and Jhaukhel villages (right) (Paper I).

I chose Duwakot and Jhaukhel for three reasons. First, the two collaborating medical institutes, Kathmandu Medical College (KMC) and Nepal Medical College (NMC), have community hospitals in Duwakot and Jhaukhel, making them suitable both practically and logistically. Second, because project researchers, including myself, had been working in these communities as faculty of KMC’s Department of Community Medicine, it was more convenient to work with the residents of these villages. Third, the rapidly urbanizing trend of
Duwakot and Jhaukhel and their proximity to Kathmandu provided a good platform to study the lifestyle-related conditions I was interested in.

After its establishment, JD-HDSS became a setting for different studies, including research on community-based cardiovascular health literacy and behavior issues. This cardiovascular health component of JD-HDSS has been termed HARDIC (Heart-Health Associated Research and Dissemination In the Community). Interestingly, HARDIC translates to “heartily” in the Nepalese language. Other ongoing research in JD-HDSS includes studies on smoking, neonatal health, and uterine prolapse.

The overall objectives of JD-HDSS were to develop an epidemiological surveillance system in Nepal to produce basic population-based health data; serve as a background and sampling frame for specific studies, especially longitudinal studies; create formal training capabilities, particularly for epidemiological training of research students; and provide evidence to policymakers for better policies/health care interventions.

Although listed as villages for administrative purposes, Jhaukhel and Duwakot are quickly transforming into peri-urban areas. Hence, the Papers used the terms peri-urban, semi-urban, and urbanizing, along with villages or VDCs, to describe these fast-changing areas. Situated 1,401 m above sea level and covering 5.41 km², Jhaukhel has a health post operated by the governmental health system and headed by a health assistant. NMC operates a community hospital in Jhaukhel. In addition, JD-HDSS office is located on the premises of the NMC Community Hospital. Duwakot is situated 1,367 m above sea level and covers 6.42 km². Apart from a governmental health post, the locality is served by Kathmandu Medical College Community Hospital, which provides general and specialist services.
Research design

The mixed methods design of this Thesis combines four quantitative studies and one qualitative study, a strategy often termed “multiple-study” mixed methods (70). I conducted the studies separately and completed the quantitative studies first. Papers I–IV used quantitative methods to report the baseline findings of JD-HDSS (Paper I); assess the cardiovascular KAP/behavior status of the community (Paper II); and estimate physical activity level (Paper III) and fruit and vegetable consumption (Paper IV). In Paper V, I conducted in-depth interviews to explore the experiences and perceptions of heart diseases among individuals already affected by cardiometabolic diseases.

The point of interface (71) between the qualitative studies (Papers II–IV) and the qualitative study (Paper V) is triangulation at the level of interpretation (72). I used the health behavior theories to enhance and enrich the cardiovascular health issues from a community perspective. Indeed, inclusion of both quantitative and qualitative methods in this Thesis provided an opportunity to do a more comprehensive research on Nepal’s cardiovascular health issues (73). Furthermore, in-depth interviews further validated quantitative data on the community’s perceptions about lifestyle-related factors, such as physical activity. Similarly, the qualitative findings allowed retrospective reflection on the results of the quantitative data through the lens of health behavior models.

Sampling

Table 1 outlines the sampling details. For baseline JD-HDSS data (Paper I), all households in the nine administrative units or wards of Jhaukhel and Duwakot were enlisted and a detailed survey of each household was carried out.
Research design

The mixed methods design of this Thesis combines four quantitative studies and one qualitative study, a strategy often termed “multiple-study” mixed methods (70). I conducted the studies separately and completed the quantitative studies first. Papers I –IV used quantitative methods to report the baseline findings of JD-HDSS (Paper I); assess the cardiovascular KAP/behavior status of the community (Paper II); and estimate physical activity level (Paper III) and fruit and vegetable consumption (Paper IV). In Paper V, I conducted in-depth interviews to explore the experiences and perceptions of heart diseases among individuals already affected by cardiometabolic diseases.

The point of interface (71) between the qualitative studies (Papers II –IV) and the qualitative study (Paper V) is triangulation at the level of interpretation (72). I used the health behavior theories to enhance and enrich the cardiovascular health issues from a community perspective. Indeed, inclusion of both quantitative and qualitative methods in this Thesis provided an opportunity to do a more comprehensive research on Nepal’s cardiovascular health issues (73). Furthermore, in-depth interviews further validated quantitative data on the community’s perceptions about lifestyle-related factors, such as physical activity. Similarly, the qualitative findings allowed retrospective reflection on the results of the quantitative data through the lens of health behavior models.

Sampling

Table 1 outlines the sampling details. For baseline JD-HDSS data (Paper I), all households in the nine administrative units or wards of Jhaukhel and Duwakot were enlisted and a detailed survey of each household was carried out.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Sampling unit</th>
<th>Sampling method</th>
<th>Sample size</th>
<th>Response rate, N (%)</th>
<th>Complete data, N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Households</td>
<td>Census</td>
<td>2,825</td>
<td>2,712/2,825 (96)</td>
<td>2,712/2,712 (100)</td>
</tr>
<tr>
<td>II</td>
<td>Primary (6 of 18 wards in Jhaukhel and Duwakot)</td>
<td>Simple random sampling</td>
<td>6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Secondary (households in the 6 wards)</td>
<td>All</td>
<td>840</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Tertiary (one 25–59-year-old adult from each household)</td>
<td>Kish technique</td>
<td>840</td>
<td>789/840 (93.9)</td>
<td>777/789 (98.5)</td>
</tr>
<tr>
<td>III</td>
<td>As in II</td>
<td>As in II</td>
<td>840</td>
<td>789/840 (93.9)</td>
<td>640/789 (81.1)</td>
</tr>
<tr>
<td>IV</td>
<td>As in II</td>
<td>As in II</td>
<td>840</td>
<td>789/840 (93.9)</td>
<td>777/789 (98.5)</td>
</tr>
<tr>
<td>V</td>
<td>Patients with heart disease, hypertension, or diabetes</td>
<td>13</td>
<td>13/13 (100)</td>
<td>13/13 (100)</td>
<td></td>
</tr>
</tbody>
</table>

For Papers II-IV, three of the nine wards from both Jhaukhel and Duwakot (n=6) were randomly selected (Table 2).
Table 2: Number of households and male and female population aged 25–59 years in the six selected wards in Jhaukhel and Duwakot.

<table>
<thead>
<tr>
<th>Area</th>
<th>Households (N)</th>
<th>Population aged 25–59 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>Jhaukhel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ward 2</td>
<td>89</td>
<td>113</td>
</tr>
<tr>
<td>Ward 3</td>
<td>119</td>
<td>142</td>
</tr>
<tr>
<td>Ward 5</td>
<td>121</td>
<td>177</td>
</tr>
<tr>
<td>Sub-total</td>
<td>329</td>
<td>432</td>
</tr>
<tr>
<td>Duwakot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ward 2</td>
<td>169</td>
<td>224</td>
</tr>
<tr>
<td>Ward 4</td>
<td>92</td>
<td>133</td>
</tr>
<tr>
<td>Ward 8</td>
<td>250</td>
<td>276</td>
</tr>
<tr>
<td>Sub-total</td>
<td>511</td>
<td>633</td>
</tr>
<tr>
<td>Total</td>
<td>840</td>
<td>1,065</td>
</tr>
</tbody>
</table>

The basis of choosing 6 of 18 wards was purely logistic. The original study design used ‘panel studies’ that randomly grouped all 18 wards into 3 batches, each containing 6 wards. However, time and budget constraints and other practicalities limited the study to the first batch (i.e., three wards each from Duwakot and Jhaukhel) in a single cross-sectional study.

Using the baseline household list, we determined that 2,148 people aged 25–59 years resided in the selected wards and calculated that we needed to visit 840 households (Table 2). Because we intended to interview one individual aged 25–59 years in each household, the study covered 840 out of those 2,148 (39.1%) people. There were altogether 12,752 individuals in this age group in the whole of Duwakot and Jhaukhel, and the study covered 840/12752 (6.7%) of them.
**Oversampling of female respondents**

The data collection process unintentionally oversampled women for Papers II–IV. First, the overrepresentation of women would have been expected if the population itself contained more women than men. However, the baseline census in the study site (Paper I) showed a male to female ratio of 1.010. Second, enumerators had applied the Kish technique when selecting a single respondent from households with more than one eligible candidate (74). The Kish technique, which is based on probability sampling theory, is widely used because every adult in a population has equal probability of selection, and the selected sample closely represents the demographic characteristics of the surveyed population (75). In terms of equal probability of selection, the Kish technique outscores not only quasi-probability techniques such as the next or last birthday method but also non-probability sampling techniques such as the Troldahl-Carter or quota methods (76). However, the Kish technique has oversampled women in other settings (77), particularly in populations that differ drastically in age-sex composition from the 1950s’ American population on whom the technique was originally based. However, many enumerators in my study may not have applied the Kish technique due to lengthy administrative time requirements and also due to the intrusiveness of the questions (76), a trait reported in other settings (77). Consequently, the enumerators simply may have interviewed the first contact available, usually a woman because women were more available during daytime hours and also were more likely to participate. Besides, most of the enumerators were women who, for social reasons, were more likely to interview women than men. Nevertheless, I addressed this important issue of disproportionate sampling at the analysis level by stratifying the results according to gender, particularly when findings differed markedly among men and women.
Another data collection issue involved respondent cooperation. For the most part, respondents were cooperative, as reflected by the high response rates: 96% for Paper I; 93.9% for Papers II–IV, which were all based on the same data set; and 100% for Paper V. Several reasons may account for the high response rates. First, Nepalese society considers it impolite to turn somebody away when he/she is at the doorstep; this is especially true in more rural settings. Second, the enumerators were from the same locality and most of them were women, which can positively influence respondent participation. Third, enumerators visited households as many as three times when they were not able to access the potential candidate. Fourth, it is possible that the high response rate could have resulted from enumerators interviewing any available adult in the household, particularly if the Kish-selected candidate did not agree to participate, resulting in a selection bias that favored more cooperative respondents.

Despite the high response rate, many respondents hesitated to answer some questions (e.g., questions related to migration) (Paper I). Several respondents refused to undergo anthropometric measurement or all three blood pressure readings (Paper III). Such refusals can lead to information bias.

Other possible biases
Paper V, in which I interviewed patients, includes a possibility of recall bias regarding questions that explored feelings at the time of diagnosis because some interviewees had been ill for several decades. Additionally, most interviewees could have had a positive opinion about healthcare facilities and personnel because my colleague and I (both doctors) conducted the interviews in a hospital, even though we were not the treating doctors. Additionally, the study sample may be considered heterogeneous because it consisted of patients with hypertension, diabetes, ischemic heart disease, arrhythmia, and valvular heart disease.
Data collection
Details of data collection process are summarized in Table 3.

Table 3: Characteristics of data collection.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Year</th>
<th>Data type</th>
<th>Interviewers (N)</th>
<th>Interview type</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2010</td>
<td>Primary</td>
<td>Enumerators (18)</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>II</td>
<td>2011</td>
<td>Primary</td>
<td>Enumerators (12)</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>III</td>
<td>2011</td>
<td>Primary</td>
<td>Enumerators (12)</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>IV</td>
<td>2011</td>
<td>Primary</td>
<td>Enumerators (12)</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>V</td>
<td>2013</td>
<td>Primary</td>
<td>PhD students (2)</td>
<td>Face-to-face, in-depth</td>
</tr>
</tbody>
</table>

Enumerators collected quantitative data during face-to-face interviews and also recorded anthropometric and blood pressure measurements. The enumerators lived in the area and had completed schooling through at least Grade 10. Most enumerators were women. Before each phase of data collection, all enumerators received five days of training from the research team, including myself. Enumerators pre-tested the questionnaire in nearby Changunarayan Village. Qualitative data collection was conducted by me and a colleague (Natália Oli, a fellow PhD student at University of Gothenburg). We conducted in-depth interviews with patients having manifest CVD, hypertension, or diabetes. We recorded these interviews on a tape-recorder (Sony Digital Voice Recorder ICDUX523B).

Tools and definitions
Table 4 provides a brief overview of the structure of questionnaires used and the main variables studied in the individual papers, followed by details about the tools and definitions used in Papers I–V.
Table 4: Types of questionnaire used and main variables studied.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Questionnaire</th>
<th>Main variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Closed</td>
<td>Demographic and fertility-related indicators, vital events, morbidity and mortality data</td>
</tr>
<tr>
<td>II</td>
<td>Closed/open</td>
<td>Knowledge on causes of heart disease, actions in case of a heart attack, preventability; attitude towards heart health; practice toward heart health</td>
</tr>
<tr>
<td>III</td>
<td>Closed</td>
<td>Physical activity measured as METS/min in three domains (i.e., work, travel and leisure); prevalence of physical inactivity in terms of sociodemographic correlates</td>
</tr>
<tr>
<td>IV</td>
<td>Closed</td>
<td>Average fruit and vegetable intake (days/week and servings/day)</td>
</tr>
<tr>
<td>V</td>
<td>Open</td>
<td>Perceptions on heart disease, risk factors, preventability, own experience, coping mechanisms, social dimensions</td>
</tr>
</tbody>
</table>

Paper I

The questionnaire for the baseline survey of the surveillance site was based on the FilaBavi and Dodalab HDSS model developed in Viet Nam and adapted to the local Nepalese context (78). The questionnaire contained questions on demographic parameters including vital events, health and health-seeking behaviors, and socioeconomic and environmental factors. Socioeconomic class has been defined using Kuppuswamy’s socioeconomic status scale, modified to the Nepalese context (79). Enumerators recorded any illness experienced during the 4 weeks immediately preceding the survey. Attrition by death was assessed on the basis of respondents’ answers.
**Paper II**

Demographic information and behavioral and physical measurements were based on the instruction manual of the WHO-STEPS Instrument (80). Current smokers were defined as those who responded “yes” to “Do you smoke?” Past smokers were defined as those who replied “yes” to “Did you ever smoke in the past?” Ever drinkers indicated they had “consumed a drink that contained alcohol ever in their lifetime,” and current drinkers indicated that they had consumed alcohol within the previous month. Increased waist circumference referred to waist measurements \( \geq 80 \) cm (females) and \( \geq 90 \) cm (males). Waist/hip ratio \( \geq 0.85 \) in females and \( \geq 0.90 \) in males was considered high. Hypertension included those with known history of hypertension (diagnosed cases) and those diagnosed during the study according to the criteria established by the Joint National Committee VII (81).

Questions on KAP/behavior were based on various resources (32, 55, 82–97). In some parts of the knowledge section, we used unprompted (open-ended) questions followed by prompted (closed-ended) questions for the same topic. Prompted-response questions showed sharply increased acknowledgment of given options as risk factors, even for incorrect options. This elicited a debate on whether unprompted or prompted questions are a true measure of one’s knowledge (98, 99). Response to prompted questions is easier because the respondent simply needs to recognize the options, and he/she may do some “guess-work” even without actually knowing the options. On the other hand, unprompted questions require the respondent to mentally retrieve and synthesize the answers (98, 99).

Although I assert that unprompted responses are superior measures of knowledge, I had to use the prompted responses to calculate knowledge scores because I needed a denominator (i.e., “full marks”) to calculate percentages. I also scored cardiovascular health attitude and practice/behavior responses, all
based on closed-ended questions. Maximum scores possible for the three domains were 53, 56, and 25.

*Paper III*

Demographic information and behavioral and physical measurements were based on the instruction manual of the WHO-STEPs Instrument (80). Level of physical activity was assessed according to the Global Physical Activity Questionnaire (GPAQ) version 2 (100, 101) and included questions on physical activity at work, during travel to and from places, and during leisure. Respondents were asked about days per week and time per day they spent doing vigorous (e.g., heavy load lifting) and moderate (e.g., carrying light loads) activities at work; continuous walking or cycling for ≥10 minutes during commute to work, market, etc; and vigorous (e.g., intense sports) and moderate activity (e.g., swimming) during leisure.

Metabolic equivalents (METs) are commonly used to express the intensity of physical activity (101). MET is the ratio of a person’s working metabolic rate relative to the resting metabolic rate. One MET is defined as the energy cost of sitting quietly and is equivalent to a caloric consumption of 1 kcal/kg per hour. As outlined in the instruction manual, all durations of physical activities were first converted to MET-minutes/week by multiplying time (minutes per day) by the number of days on which that activity was done per week, and further multiplying the product by eight for vigorous activity and by four for moderate activity (e.g., cycling or walking for transport) (101). Compared to sitting quietly, estimates suggest that a person's caloric consumption increases four-fold during moderate activity and eight-fold during vigorous activity.

Total physical activity (TPA) was calculated by adding together MET-minutes of all the activities. Depending on their total MET-minutes/week or other combination criteria, the respondents’ physical activity was categorized as high, moderate, and low. “High activity” indicates a person who engages in
vigorous-intensity activity at least 3 days/week and achieves at least 1,500 MET-minutes/week, or who completes any combination of walking or moderate or vigorous activities on 7 or more days and achieves at least 3,000 MET-minutes/week. “Moderate activity” identifies a person who does not meet the criteria for “high activity,” but completes either 3 or more days of vigorous-intensity activity for at least 20 minutes/day, or 5 or more days of moderate intensity activity (i.e., at least 30 minutes/day, or 5 or more days of any combination of walking or moderate- or vigorous-intensity activities), achieving a minimum of at least 600 MET-minutes/week. “Low activity” describes a person who did not meet any of the above criteria. In addition, we classified respondents according to the WHO-recommended minimum, i.e., 150 or 75 minutes of moderate or vigorous aerobic physical activity, respectively or an equivalent combination of moderate- and vigorous-intensity activity throughout the week (102).

Paper III measured the sociodemographic correlates of physical activity and used the self-reported questionnaire. Classifying population on the basis of self-reported physical activity suffers from an innate weakness of recall bias, which is reported mainly for moderate-level activities (19). Nevertheless, the self-reported questionnaire provides data for comparison with methodologically similar national and international data. In addition, more accurate objective measurements using accelerometers were not feasible in my study setting. Further, although important in understanding the ecology of physical activity, I did not venture into studying the built environment of the study setting and its relation with physical activity of the study population. Indeed, a full picture of the epidemiology of physical activity can be understood only by including physical and built environment and the psychosocial correlates of physical activity (103, 104).
**Paper IV**

Demographic information for Paper IV was based on the instruction manual of the WHO-STEPs Instrument (80). To assess fruit and vegetable intake, we asked respondents to report the number of days/week and servings/day that they consumed fruit and vegetables. “Low fruit and vegetable intake” was defined as consuming less than the five WHO-recommended servings of fruit and vegetables.

The study largely focused on quantifying fruit and vegetable intake. It did not explore different factors in the study community that might influence intake. Ecology of the terrain, availability, and affordability are known determinants of fruit and vegetable intake (105–108). Likewise, habits (including those of parents), attitudes, motivation, knowledge, and taste preferences influence fruit and vegetable consumption (105).

**Paper V**

Data were collected through open-ended questions using an in-depth interview guide. The guide was developed using relevant literature (109–116) and by consulting researchers with experience in qualitative studies. Pre-testing was done with two hypertensive patients (i.e., one 74-year-old male and one 39-year-old female). I participated in all aspects of the study. For the data collection process, I functioned as an interviewer along with my colleague. I have previous research experience in community-based cardiovascular health.

**Data management**

For Papers I–IV, enumerators collected data on questionnaire sheets, which they carried in shoulder bags. At the end of each day, all enumerators met with field supervisors in the JD-HDSS office. The supervisors checked the completed questionnaires and instructed the enumerators to revisit households and collect any missing information. On a weekly basis, enumerators securely deposited
completed questionnaires at the JD-HDSS office at NMC Community Hospital, Jhaukhel. These filled forms were stacked in steel racks according to codes developed for the purpose.

Under close supervision, a team of public health graduates entered data into Epidata software version 3.1. I and other colleagues checked for any inconsistency. We held regular meetings and presentations to update the data entry progress. For the qualitative study (Paper V), data was present in two formats (i.e., tape recordings and interview notes). Both formats were securely kept in my office. Only those involved in the research had access to the data.

**Data analysis**

Because this Thesis contains both quantitative and qualitative data, I analyzed the data accordingly (Table 5). I used statistical analyses packages, such as Statistical Package for Social Sciences (SPSS) and STATA, for quantitative analysis and also applied relevant tests of significance. I considered \( p<0.05 \) as statistically significant. Analyses for risk factors, such as hypertension, physical activity, and fruit and vegetable intake, follow the guidelines provided in the manual of the WHO-STEPs Non-Communicable Disease Risk Factors Survey (80). We used qualitative content analysis to analyze qualitative data (117). Data from quantitative and qualitative studies were not triangulated during data analysis, but rather at the interpretation level. Table 5 provides details of the data analysis procedure for each paper.
Table 5: Summary of data analysis.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Data analysis software</th>
<th>Analysis</th>
<th>Tests of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>SPSS 17.0, STATA 10.0</td>
<td>Descriptive statistics: categorical data as percentage; continuous data as median mean and standard deviation; rates and ratios</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inferential statistics: multivariate regression</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>SPSS 17.0, STATA 10.0</td>
<td>Descriptive statistics: categorical data as number and percentages; continuous data as median and interquartile range</td>
<td>Mann-Whitney U test, Chi-square test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spearman’s correlation</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>SPSS 17.0, STATA 10.0</td>
<td>Descriptive statistics: categorical data as number and percentages; continuous data as median</td>
<td>Spearman’s correlation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inferential statistics: correlation analysis; multivariate regression</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>SPSS 17.0, STATA 10.0</td>
<td>Descriptive statistics: categorical data as number and percentages; continuous data as mean and standard deviation</td>
<td>Student t-test; Analysis of Variance</td>
</tr>
<tr>
<td>V</td>
<td>Manual</td>
<td>Qualitative content analysis</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
Paper I
Nominal data are presented as percentages. Continuous variables are expressed as mean and standard deviations. Various crude and specific rates and ratios were calculated for fertility, morbidity, and mortality. Further, I conducted age-adjusted multivariate analysis of composite self-reported prevalence of the NCDs (CVDs including hypertension, cancer, and diabetes).

Paper II
The KAP/behavior components of the questionnaire were given scores, and higher score indicated better KAP/behavior. Maximum possible scores were 53, 56, and 25 for knowledge, attitude and practice/behavior, respectively. I converted the individual score into percent of maximum score, and calculated median percent scores for each subset of the study population (e.g., median percent score of knowledge among men). Also, the percent scores were classified into five categories based on the quintile values: highly insufficient (≤20%), insufficient (20%–40%), sufficient (41%–60%), satisfactory (61%–80%), and highly satisfactory (>80%) (97).

Descriptive statistical analysis was performed. Categorical data were presented as numbers and percentages, and continuous data were presented as median and interquartile range (IQR). Chi-square and Mann-Whitney U tests were applied to compare proportions and medians, respectively.

Paper III
The questionnaire on physical activity and its analysis and interpretation are based on the GPAQ and the WHO-STEPS manual (80, 101). MET-minutes per week is considered the basic unit of physical activity, and its median values were calculated for work, travel, and leisure. LPA is defined as those individuals not meeting the GPAQ criteria for high or moderate physical activity. To calculate the odds of having LPA, high and moderate physical activity was arbitrarily combined into one group: moderate to vigorous physical activity. Using
multivariate analysis, we calculated odds ratios and 95% CI for having LPA for the various sociodemographic and risk factor substrata. Spearman’s correlation coefficient was calculated to test the correlation between non-normal continuous variables. I also computed the percentage of study population meeting the WHO recommendations for physical activity (102).

The analysis excluded 137 of the 777 respondents because mandatory data on 3 blood pressure readings or anthropometric measurements were missing. This resulted in an 18% reduction in the final sample, but improved the internal validity of the study.

*Paper IV*

Demographic parameters were measured as nominal variables and expressed in numbers and percentages. Fruit and vegetable intakes are presented as means and standard deviations. Student $t$-test and analysis of variance (ANOVA) were applied to compare the average values across each sociodemographic variable. Results are presented separately for men and women.

*Paper V*

The data was analyzed manually applying qualitative content analysis. The analysis focused on manifest content (i.e., visible and obvious components). First, the data from the tape recordings, complemented by the field notes, were transcribed verbatim and translated from Nepalese language into English. Meaningful units were extracted from the transcripts and condensed, and codes were generated (Table 6).
multivariate analysis, we calculated odds ratios and 95% CI for having LPA for the various sociodemographic and risk factor substrata. Spearman’s correlation coefficient was calculated to test the correlation between non-normal continuous variables. I also computed the percentage of study population meeting the WHO recommendations for physical activity (102).

The analysis excluded 137 of the 777 respondents because mandatory data on 3 blood pressure readings or anthropometric measurements were missing. This resulted in an 18% reduction in the final sample, but improved the internal validity of the study.

### Table 6: Example of meaningful units: condensation and abstraction.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Meaningful Units</th>
<th>Condensed Meaningful Units</th>
<th>Codes</th>
<th>Sub-sub categories</th>
<th>Sub categories</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>R7</td>
<td>Causes of heart disease include smoking and excessive alcohol</td>
<td>Smoking and excessive alcohol cause heart disease</td>
<td>Smoking</td>
<td>Smoking</td>
<td>Risk factors</td>
<td>Heart disease linked to diet and other health behaviors</td>
</tr>
<tr>
<td>R13</td>
<td>Festivals affect health and heart due to greater consumption of alcohol and high-content fats, spices, oily foods.</td>
<td>Festivals affect heart due to high consumption of alcohol, spices, and fat.</td>
<td>Festivals</td>
<td>Effect of tradition and culture</td>
<td>Socio-demographic environment</td>
<td></td>
</tr>
</tbody>
</table>
Three researchers, who were involved in the study, including myself, examined the transcripts separately. The researchers discussed the transcripts regularly until they reached a consensus for various categories, subcategories, and sub-subcategories (Table 7).

Table 7: Categories, sub-categories and sub-subcategories in Paper V.

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategories</th>
<th>Sub-subcategories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease linked to diet and other health behaviors</td>
<td>General health</td>
<td>Understanding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Responsibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health problems in the community</td>
</tr>
<tr>
<td>Heart disease</td>
<td></td>
<td>Diet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physical activity</td>
</tr>
<tr>
<td>Risk factors</td>
<td></td>
<td>Smoking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alcohol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Body weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blood pressure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Others</td>
</tr>
<tr>
<td>Socio-demographic environment</td>
<td></td>
<td>Effect of tradition and culture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Role of peers</td>
</tr>
<tr>
<td>Personal distress, financial difficulties and family support</td>
<td>Personal</td>
<td>Feelings at diagnosis and at present</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Support of family and neighbors</td>
</tr>
<tr>
<td>Health care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifestyle modifications are well understood, but difficult to follow</td>
<td>Efforts</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continuity and success</td>
</tr>
<tr>
<td>Awareness of heart disease is too little, too late</td>
<td>Level of awareness in the community</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suggestions for improving awareness</td>
</tr>
</tbody>
</table>
Ethical considerations

Permission to operate a surveillance site in Duwakot and Jhaukhel villages materialized through formal and informal discussions at different levels. At the authority level, I met with personnel of the Ministry of Health and Population, who confirmed the Ministry’s support. Official permission to conduct the studies was obtained from the Nepal Health Research Council, which is the research wing of the Ministry and the main authority of health-related research in Nepal. I also obtained ethical clearance from the Institutional Review Board of Kathmandu Medical College. At the local level, I initially and regularly consulted local political and health leaders regarding any pertinent issue and periodically briefed them regarding progress. Although often unwritten, their support remained critical to the studies.

At the household level, the enumerators explained the objectives of the study to the respondents and sought their written consent. Because people generally hesitate to sign documents for they fear misuse, enumerators asked for verbal consent if a respondent wanted to participate in the study but did not want to give written consent. This process was implemented in all five studies (Papers I–V). Further, we obtained additional permission from respondents for tape recording and note taking during in-depth interviews (Paper V).

Before beginning an interview, enumerators told respondents for the quantitative (Papers I–IV) and qualitative studies (Paper V) that they were free to terminate the interview at anytime. We also told them that they could skip any question or a particular section of the questionnaire if they were not comfortable with that question or section. For example, a few respondents answered the questions but did not want to have their anthropometric measurements taken.

All interviews for the quantitative studies (Papers I–IV) were conducted in the households of the respondents. Of the 13 in-depth interviews in the qualitative study (Paper V), all but 1 interview was conducted in the community hospital of Kathmandu Medical College at Duwakot. Confidentiality of the
interviews was maintained by avoiding potential onlookers, usually by conducting the interviews indoors or separately.

Data security was rigorously maintained. Completed forms were securely kept in the HDSS office at the community hospital of Nepal Medical College at Jhaukhel. Only the research team had access to the digital data. No name of any individual respondent, including the interviewees of the qualitative study, appears in the published papers or the thesis.

Study participants were exposed to no apparent risk, physical or psychological. However, some participants (e.g., Brahmin women) may have considered a few questions offensive, such as those on alcohol consumption. Inquiry about intake of fruits and vegetables might be embarrassing for some because it may reflect their purchasing capacity. Enumerators were told to handle such situations sensibly. Additionally, the in-depth interviews (Paper V) explored the experiences of patients with cardiovascular conditions, which potentially could touch upon both sensitive and emotional aspects.

Study respondents received no monetary benefit, either directly or in the form of a gift. Respondents identified as needing health services, including those with newly diagnosed hypertension, were referred to the community hospitals of either KMC or NMC with a provision for discounted consultation fees.
RESULTS

Paper I: Establishing a health demographic surveillance site in Bhaktapur district, Nepal: initial experiences and findings

Paper I presents two aspects of the HDSS establishment in Duwakot and Jhaukhel villages in the Bhaktapur district of Nepal: experience of the initiation of the HDSS itself, and findings of the baseline study conducted in 2010. The main objectives of establishing JD-HDSS were to (i) collect baseline data on sociodemographic and vital events; (ii) identify the prevalent health problems, with a focus on NCDs; and (iii) provide appropriate sampling frames for future studies.

Eighteen enumerators surveyed 2,712 households (1,155 in Jhaukhel and 1,557 in Duwakot) during 3 months in 2010 and collected information on 13,669 individuals (6,057 in Jhaukhel and 7,612 in Duwakot). The median age for both sexes was 27 years, and adults comprised 69.9% of the total population. Males accounted for 51% of the total population. The major three ethnic groups were Brahmin, Chhetri, and Newar. The illiteracy rate for individuals >6 years of age was 18.2%. More than two thirds of the population was economically active, and about 2% of the population had migrated from other parts of Nepal.

The crude birth rate in the JD-HDSS population was 9.7/1,000; about 10% of all births occurred at home. The crude death rate was 3.9/1,000 per year and we recorded no deaths among infants or children younger than 5 years. Two thirds of all deaths were registered. About one third of deaths were premature (<65 years of age). NCDs such as CVDs, hypertension, diabetes, and cancer were the leading causes of mortality. Along with respiratory problems, NCDs were also the main causes of morbidity in the community (Figure 5). Thus, Paper I justified further studies of CVDs in the community. In addition, Paper I
illustrated diversity in healthcare utilization: 20% of our respondents visited traditional healers when they were ill (Figure 6).

Figure 5: Causes of morbidity in the JD-HDSS (multiple responses).

Figure 6: Health service utilization by people during illness (multiple answers).
Paper II: Cardiovascular health knowledge, attitude, and practice/behaviour in an urbanizing community of Nepal: a population-based cross-sectional study from Jhaukhel-Duwakot health demographic surveillance site

Paper II assessed the status of cardiovascular health KAP/behavior in a sample population in JD-HDSS. We aimed to interview one adult aged 25–59 years from each of the 840 households in the randomly selected six clusters (administrative units, or wards).

Study population
Seventy percent of the respondents were female; one third lacked formal education and two thirds were housewives. Among 229 male respondents, about 20% worked in agriculture and one third was either into service or self-employed. Of the 777 respondents with complete information, approximately one third belonged to each of the three age-group intervals (25–34, 35–44, and 45–59 years).

Risk factors
Tobacco and alcohol consumption was higher in males than females (current smoking [33.5% vs. 14.7%], smokeless tobacco [20.2% vs. 3.3%], and current drinking [34.5% vs. 12.6%], respectively). On the other hand, metabolism-related risk factors were more prevalent in females than males (low physical activity [45.2% vs. 38.3%], overweight [31.6% vs. 25.0%], obesity by body mass index [11.2% vs. 5.4%], and increased waist circumference [56.6% vs. 21.6%], respectively).

Knowledge about causes of heart diseases
When asked to spontaneously name the reasons why people suffer from heart disease, respondents showed low overall knowledge, ranging from 1.0% for high blood sugar to 29.2% for smoking (Table 8). Generally, males, younger
respondents, better-educated individuals, and governmental or nongovernmental employees had more knowledge.

**Table 8: Percentage of respondents citing various causes of heart disease.**

<table>
<thead>
<tr>
<th></th>
<th>Hypertension</th>
<th>High blood sugar</th>
<th>High cholesterol</th>
<th>Physical inactivity</th>
<th>Overweight</th>
<th>Smoking</th>
<th>Smokeless tobacco</th>
<th>Excessive alcohol</th>
<th>Excess stress</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>18.8*</td>
<td>1.3</td>
<td>20.5*</td>
<td>7.0</td>
<td>5.7</td>
<td>34.9*</td>
<td>8.3</td>
<td>31.4*</td>
<td>16.2</td>
</tr>
<tr>
<td>Female</td>
<td>10.9*</td>
<td>0.9</td>
<td>13.5*</td>
<td>4.0</td>
<td>5.3</td>
<td>26.8*</td>
<td>4.7</td>
<td>23.9*</td>
<td>13.5</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25–34</td>
<td>14.8</td>
<td>1.6</td>
<td>17.5</td>
<td>5.4</td>
<td>6.2</td>
<td>31.1</td>
<td>6.2</td>
<td>28.4</td>
<td>16.0*</td>
</tr>
<tr>
<td>35–44</td>
<td>13.2</td>
<td>0.4</td>
<td>17.1</td>
<td>5.7</td>
<td>6.1</td>
<td>26.8</td>
<td>5.0</td>
<td>25.0</td>
<td>17.1*</td>
</tr>
<tr>
<td>45–59</td>
<td>11.7</td>
<td>1.3</td>
<td>11.7</td>
<td>3.3</td>
<td>3.8</td>
<td>30.0</td>
<td>6.3</td>
<td>25.0</td>
<td>9.2*</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brahmin</td>
<td>14.3*</td>
<td>1.0</td>
<td>21.1*</td>
<td>7.5*</td>
<td>5.8</td>
<td>29.3</td>
<td>8.2</td>
<td>25.2</td>
<td>12.9</td>
</tr>
<tr>
<td>Chhetri</td>
<td>19.1*</td>
<td>1.0</td>
<td>16.5*</td>
<td>4.6*</td>
<td>6.7</td>
<td>32.5</td>
<td>3.6</td>
<td>25.8</td>
<td>20.1</td>
</tr>
<tr>
<td>Newar</td>
<td>10.8*</td>
<td>0.5</td>
<td>9.8*</td>
<td>3.6*</td>
<td>5.7</td>
<td>27.8</td>
<td>6.2</td>
<td>28.4</td>
<td>10.8</td>
</tr>
<tr>
<td>Minorities</td>
<td>3.2*</td>
<td>2.1</td>
<td>8.4*</td>
<td>0.0*</td>
<td>1.1</td>
<td>25.3</td>
<td>2.1</td>
<td>25.3</td>
<td>13.7</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary school</td>
<td>13.0*</td>
<td>0.8</td>
<td>14.2*</td>
<td>5.3*</td>
<td>4.5*</td>
<td>30.5</td>
<td>8.1</td>
<td>27.6</td>
<td>15.0*</td>
</tr>
<tr>
<td>Secondary school</td>
<td>15.7*</td>
<td>1.5</td>
<td>18.7*</td>
<td>8.6*</td>
<td>8.6*</td>
<td>29.8</td>
<td>3.0</td>
<td>27.8</td>
<td>16.7*</td>
</tr>
<tr>
<td>≥ High school</td>
<td>21.0*</td>
<td>1.6</td>
<td>27.4*</td>
<td>4.8*</td>
<td>8.9*</td>
<td>33.9</td>
<td>8.1</td>
<td>26.6</td>
<td>18.5*</td>
</tr>
<tr>
<td>Non-formal</td>
<td>6.7*</td>
<td>0.5</td>
<td>7.2*</td>
<td>1.0*</td>
<td>1.4*</td>
<td>24.4</td>
<td>4.3</td>
<td>22.5</td>
<td>8.6*</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employee</td>
<td>26.7*</td>
<td>0.9</td>
<td>32.8*</td>
<td>10.3</td>
<td>8.6</td>
<td>30.2</td>
<td>8.6</td>
<td>31.9</td>
<td>23.3*</td>
</tr>
<tr>
<td>Self-employed</td>
<td>17.6*</td>
<td>2.8</td>
<td>14.8*</td>
<td>1.9</td>
<td>7.4</td>
<td>29.6</td>
<td>2.8</td>
<td>25.9</td>
<td>15.7*</td>
</tr>
<tr>
<td>Housewife</td>
<td>10.6*</td>
<td>1.1</td>
<td>11.7*</td>
<td>3.3</td>
<td>5.4</td>
<td>25.7</td>
<td>3.5</td>
<td>23.8</td>
<td>13.0*</td>
</tr>
<tr>
<td>Agriculture</td>
<td>7.1*</td>
<td>0.0</td>
<td>14.3*</td>
<td>7.1</td>
<td>1.6</td>
<td>37.3</td>
<td>8.7</td>
<td>26.2</td>
<td>11.1*</td>
</tr>
<tr>
<td>Others</td>
<td>8.6*</td>
<td>0.0</td>
<td>10.3*</td>
<td>5.2</td>
<td>3.4</td>
<td>31.0</td>
<td>13.8</td>
<td>29.3</td>
<td>8.6*</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>13.3</td>
<td>1.0</td>
<td>15.6</td>
<td>4.9</td>
<td>5.4</td>
<td>30.2</td>
<td>5.8</td>
<td>26.1</td>
<td>14.3</td>
</tr>
</tbody>
</table>

Notes: Figures are based on participants’ spontaneous responses. The table includes only established CVD risk factors and excludes responses that cited other non-established causes (e.g., food hygiene, air pollution, etc.). Calculated with Chi-square test, p-values compare all categories in the variables. *p<0.05; *p<0.01.
Questions on causes of heart disease were repeated in a closed-ended manner that stated the risk factors and provided “yes/no” options. When asked in this manner, respondents appeared to have greater knowledge about the causes of heart disease compared to the earlier spontaneous responses; the percentage of respondents saying “yes” to the risk factors increased considerably (Figure 7).

Figure 7: Comparison of spontaneous and prompted responses (%) given for cause of heart disease.

Knowledge about heart attack: signs and management

Almost 60% of respondents did not know any sign of a heart attack, 20% knew one sign, and 20% mentioned 2–4 signs. These percentages were true across all demographic subsets and showed no significant differences in terms of gender ($p>0.05$), age ($p=0.49$), caste/ethnicity ($p=0.40$), and education ($p=0.53$). Loss of consciousness (23.7%) was the most common sign mentioned, followed by chest
pain (14.3%), difficulty in breathing (10.6%), and dizziness (10.2%). Knowledge of chest pain, which is the most prominent and important indicator of heart attack, varied widely across the subsets. Younger age group, Brahmin caste, better educated, and job-holders mentioned chest pain more often.

Similar to the assessment of knowledge on causes of heart disease, a repeated question about warning signs, this time with prompts, yielded a much better knowledge status (Figure 8). Notably, responses to the incorrect warning signs, such as pain in the legs and abdomen, also increased when questions were repeated in this manner.

![Figure 8: Comparison of spontaneous and prompted responses (%) for warning signs of heart attack.](image)

When asked what action they would take for a suspected heart attack, 75% of respondents said they would take the affected person to a hospital.
However, 20% of respondents gave no response, and the remaining 5% said they would try home therapy or consult a traditional healer.

**Knowledge about heart-healthy food**

Overall knowledge about heart-healthy food was good, particularly regarding green vegetables and fruit, which 94.6% and 92.1% of respondents believed to be healthy, respectively. High fat-containing foods like ghee (clarified butter) and traditional sweets were considered healthy by 6.7% and 13.3% of respondents, respectively. Similarly, 7.6% and 8.4% of respondents considered fried and processed foods heart-healthy, respectively. Regarding animal products, 12.2% of respondents perceived red meat as a heart-friendly food and 24.5% thought that eggs are healthy. However, only one quarter of the respondents considered fish as healthy, and 21.8% thought that salty food items (e.g., pickles) are healthy. Knowledge of heart-healthy food associated with neither socioeconomic variables (age, sex, ethnicity, educational status, and occupation) nor diagnosed health status, such as hypertension and diabetes.

**Knowledge about preventability of heart disease**

A large majority (86.1%) of respondents thought that it was possible to prevent heart disease by changing their lifestyle. Percentages of affirmative responses to specific actions that reduce the risk of heart disease were as follows: reducing fat intake (93.7%), reducing stress (93.6%), quitting smoking (92.5%), maintaining a healthy blood pressure (92.3%), getting adequate physical activity (89.1%), reducing salt in the diet (88.8%), and losing weight (86.1%). In general, respondents aged 25–34 years, those with post-graduate education, and students were 5%–20% more knowledgeable about preventive actions for heart disease than their counterparts.

**Locus of control**

More than half (52.4%) of the male respondents either strongly (27.1%) or somewhat (25.3%) agreed with the notion that the locus of control of their health
was God or a higher power. The proportion was higher (60.8%) among females (strongly agreed, 38.5%; somewhat agreed, 22.3%).

**Attitude towards heart-health and prevention of heart diseases**

One quarter of respondents did not perceive themselves to be at risk for heart disease. Collaterally, a majority of respondents and more men (64.6%) than women (54.4%) did not want to improve their present lifestyle because they thought that changing their behavior would not reduce their risk. This finding is ironic because most respondents understood the benefits of preventive and promotive measures such as increasing their intake of fruit and vegetables, accessibility to recreational facilities, and banning smoking.

Although almost all respondents agreed that additional awareness programs and healthcare facilities would be useful, fewer males (82.1%) than females (98.5%) believed that local health volunteers could change adverse health behavior in the general population.

**Cardiovascular health practice**

Despite the above-mentioned resistance to changing health behavior, many respondents had participated in some heart friendly behavior in the past year, from getting a diagnostic test for heart disease (10%) to reducing their consumption of unhealthy foods (59.6%). Such actions were undertaken mostly by more educated respondents or those working as employees in government or nongovernment jobs. The reasons for respondents’ heart-healthy actions are shown in Figure 9.
was God or a higher power. The proportion was higher (60.8%) among females (strongly agreed, 38.5%; somewhat agreed, 22.3%).

Attitude towards heart-health and prevention of heart diseases

One quarter of respondents did not perceive themselves to be at risk for heart disease. Collaterally, a majority of respondents and more men (64.6%) than women (54.4%) did not want to improve their present lifestyle because they thought that changing their behavior would not reduce their risk. This finding is ironic because most respondents understood the benefits of preventive and promotive measures such as increasing their intake of fruit and vegetables, accessibility to recreational facilities, and banning smoking.

Although almost all respondents agreed that additional awareness programs and healthcare facilities would be useful, fewer males (82.1%) than females (98.5%) believed that local health volunteers could change adverse health behavior in the general population.

Cardiovascular health practice

Despite the above-mentioned resistance to changing health behavior, many respondents had participated in some heart-friendly behavior in the past year, from getting a diagnostic test for heart disease (10%) to reducing their consumption of unhealthy foods (59.6%). Such actions were undertaken mostly by more educated respondents or those working as employees in government or nongovernment jobs. The reasons for respondents' heart-healthy actions are shown in Figure 9.

It is evident from these responses that most actions were initiated after respondents had been diagnosed with a disease condition. Four of five known hypertensives and three fourths of the diabetics had their blood pressure and blood sugar measured in the previous year. One third of overweight respondents attempted to reduce their weight or improve their physical activity. Unfortunately, the mere presence of a risk factor (e.g., smoking, alcohol consumption, or inadequate physical activity) did not lead to better health-seeking behavior (e.g., blood pressure measurement or blood sugar examination) or a change in health practice. For example, only 12% of smokers attempted to quit smoking.

Figure 9: Number of respondents citing reasons for initiation of heart-friendly behavior (multiple responses).
**Comparison of KAP/behavior scores**

Responses on the knowledge (prompted), attitude, and behavior/practice sections were scored. Average scores, calculated as median percent scores on these three sections, were 79.3%, 67.8%, and 31.1%, respectively. The scores were classified into five categories based on the quintiles of the percent scores: highly satisfactory, satisfactory, sufficient, insufficient, and highly insufficient (Figure 10).

![Bar chart showing the distribution of KAP/behavior scores](chart.png)

**Figure 10:** Level of cardiovascular health KAP/behavior based on the quintiles of percent scores.

When cross-tabulated, disparities were noted between KAP/behavior levels. For example, among those with highly satisfactory knowledge, only 14.7% had highly satisfactory attitude and only 13.4% had highly satisfactory
behavior. Likewise, among those with highly insufficient knowledge, 26% had highly insufficient attitude and 16.4% had highly insufficient behavior. Similar mismatches were also observed between attitude and behavior: only 11% of those with highly satisfactory attitude also possessed highly satisfactory behavior.

Sociodemographic variations in KAP/behavior scores

The KAP/behavior scores showed no significant gender differences. On the other hand, I observed statistically significant differences for age, caste/ethnicity, and education level on knowledge and practice scores, but not for attitude.

Paper III: Physical activity level and its sociodemographic correlates in a peri-urban Nepalese population: a cross-sectional study from the Jhaukhel-Duwakot health demographic surveillance site.

Paper III describes in detail the physical activity level of an urbanizing population of Nepal. Using the standard GPAQ questionnaire, I first determined the level of physical activity in the population, and then explored physical activity in relation to different sociodemographic correlates.

Physical activity across the sociodemographic subgroups

Among the three domains of physical activity studied, work-related activities accounted for the highest level of physical activity, not travel or leisure-time physical activities (Figures 11–15). Physical activity during work was higher among females (Figure 11), respondents aged 35–44 years (Figure 12), Newars and ethnic minorities (Figure 13), those with informal education (Figure 14), and those doing agriculture-related work (Figure 15). On the other hand, physical activity during travel was lower among housewives, government employees, and
agricultural workers. Leisure activity was higher in males, Brahmins, and employees.

**Figure 11**

**Figure 12**

**Figures 11–13:** Box-and-whisker plot showing levels of physical activity in different domains (work, travel, and leisure) and total physical activity according to sex, age, and ethnicity of the respondents. Boxes show the median values of METs/min and whiskers indicate interquartile ranges.
agricultural workers. Leisure activity was higher in males, Brahmins, and employees.

Figures 1–13: Box-and-whisker plot showing levels of physical activity in different domains (work, travel, and leisure) and total physical activity according to sex, age, and ethnicity of the respondents. Boxes show the median values of METs/min and whiskers indicate the interquartile ranges.

Figure 14

Figures 14–15: Box-and-whisker plots showing levels of physical activity in different domains (work, travel, and leisure) and total physical activity according to education and occupation of the respondents. Boxes show the median values of METs/min and whiskers indicate the interquartile ranges.

Figure 15
TPA, which was obtained by combining the physical activity of the three domains, was higher in males, Newars, and those involved in agricultural work. TPA showed an inverse relationship with age and level of education: the oldest age group (45–59 years) had an adjusted odds ratio of 1.67 (1.08–2.58) of having low physical activity compared to the youngest age group (25–34 years). Likewise, those with the highest education (high school or further) had an odds ratio of 2.99 (1.65–5.46) of having low physical activity compared to those with the least education (informal education).

Low physical activity
Prevalence of LPA, as defined by GPAQ and WHO-STEPs criteria, was 43.3% (95% CI, 39.4–47.1) in the study population. Moderate physical activity was present in 50.8% (95% CI, 46.9–54.7) and high physical activity in 5.9% (95% CI, 4.1–7.8) of the population.

Cardiometabolic risk factors and physical inactivity
I observed a positive association between physical inactivity and cardiometabolic risk factors. Adjusted odds ratios of having LPA for diagnosed hypertension, diagnosed diabetes, overweight, and increased waist circumference were 1.41 (0.88–2.23), 1.64 (0.73–3.67), 1.58 (1.13–2.20), and 1.78 (1.27–2.49), respectively.

Awareness of physical inactivity as a CVD risk factor
When asked to list risk factors of cardiovascular diseases, only 5% of respondents spontaneously mentioned physical inactivity, irrespective of sociodemographic background, including educational status (Figure 7). Conversely, 89.1% answered “yes” when asked if physical exercise helped prevent heart disease.
Paper IV: Disparities in fruit and vegetable intake by socio-demographic characteristics in peri-urban Nepalese adults: findings from the Heart-Health Associated Research and Dissemination in the Community (HARDIC) Study, Bhaktapur, Nepal

Paper IV investigated the overall intake of fruit and vegetable in a sample population of JD-HDSS (Table 9).

**Table 9: Average fruit and vegetable intake in men and women.**

<table>
<thead>
<tr>
<th></th>
<th>Mean (SD)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td></td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Days/week</td>
<td>2.63 (1.97)</td>
<td>3.34 (2.17)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Servings/day</td>
<td>0.92 (0.63)</td>
<td>0.99 (0.64)</td>
<td>0.184</td>
</tr>
<tr>
<td>Vegetable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days/week</td>
<td>5.33 (1.69)</td>
<td>5.64 (1.55)</td>
<td>0.016</td>
</tr>
<tr>
<td>Servings/day</td>
<td>1.42 (0.57)</td>
<td>1.48 (0.62)</td>
<td>0.210</td>
</tr>
<tr>
<td>Fruit and vegetable combined</td>
<td>2.34 (0.88)</td>
<td>2.49 (0.93)</td>
<td>0.056</td>
</tr>
</tbody>
</table>

SD: standard deviation

**Fruit intake**

Fruit intake was particularly less than vegetable intake, both in terms of days of intake per week and number of servings. During a week, males ate fruit on 2.63 (±1.97) days compared to 3.34 (±2.17) days for women. Average number of servings per day was higher for females (0.99±0.64) compared to males (0.92±0.63). Fruit intake did not differ significantly in males and females. Ethnicity-wise, Brahmin males and females had higher fruit intake compared to other ethnicity or castes. Consumption of fruit increased with level of education for females; the association was similar for males, except for post-graduates. In terms of occupation, retired females, but not retired males, had the highest
consumption of fruit, while unemployed females (unable to work) had lowest fruit consumption.

Vegetable intake
Vegetable consumption was higher in females than in males, with 5.64±1.55 days of vegetable intake and 1.48±0.62 servings per day for women compared to 5.33±1.69 days and 1.42±0.57 for men. Both Chhetri men and Chhetri women had higher vegetable intake than their counterparts of other ethnicity and caste. Level of education did not influence vegetable intake. Vegetable consumption was highest in female students and unemployed (able to work) females, whereas unemployed (unable to work) females had the lowest intake.

Combined fruit and vegetable intake
WHO and other international agencies and associations currently recommend a minimum of five servings of combined fruit and vegetables per day. In our study population, only 2.1% of respondents consumed the recommended amount (i.e., an average of 2.34±0.88 servings per day for men and 2.49±0.93 for women). Hence, fruit and vegetable intake was inadequate in almost the entire study population: 98.3% (95% CI: 96.5-99.9) of men and 97.8% (96.5-99.0) of women (p=0.589) did not consume the minimum five servings per day.

Paper V: Experiences and perceptions about cause and prevention of cardiovascular disease among people with cardiometabolic conditions: findings of in-depth interviews from a peri-urban Nepalese community
I conducted in-depth interviews with 13 patients having established cardiometabolic conditions. I explored their perceptions about causation and preventability of heart diseases. The respondents also shared their medical, social, and psychological experience of living with heart disease.
Perceptions of heart diseases, risk factors, and sociocultural environment

Respondents placed a high value on health, and linked being “healthy” to ability to do everyday work without difficulty. Most respondents thought that their health was their own responsibility. They opined that “sugar” (diabetes mellitus) and “pressure” (hypertension) were prevalent conditions in their neighborhood.

The term “heart disease” meant different conditions to the respondents, ranging from pain in the heart to formation of a hole in the heart. Some respondents immediately associated heart disease with underlying causative factors such as smoking and heredity. Dietary factors, particularly consumption of fatty and oily food, were universally and repeatedly mentioned as the main reason why people suffer from heart disease. Similarly, respondents unanimously linked smoking, alcohol intake, and high blood pressure to cardiac ailments. However, they had varying opinions regarding the relationship of body weight and physical inactivity with heart disease.

Most respondents felt that traditional and cultural practices in Nepal contribute to heart disease. They particularly incriminated festivals, because people engage in binge eating of fatty and spicy food during such occasions, and many ethnic groups tend toward more alcohol drinking.

Experience of living with the disease: psychosocial and financial burden

All respondents reported having depressive symptoms and psychological stress when they were diagnosed with a cardiometabolic condition, but they were able to handle the situation better in the due course of time. All of them reported receiving good healthcare support from their family. However, the financial burden of managing their illness was a major issue in the family.

Lifestyle modification after diagnosis

All respondents understood the importance of lifestyle modification, such as reducing salt intake or fat consumption and cutting down on smoking and
alcohol intake, although half of them acknowledged that it was difficult to continue those behavioral modifications.

Prevention and awareness
All participants remarked that the community’s awareness of cardiovascular diseases was inadequate, and that medical doctors or trained local people should spread awareness in the community to increase people’s knowledge about the causes and effects of heart diseases and encourage them to seek medical care if necessary.
DISCUSSION

This Thesis contributes to the understanding of cardiovascular health literacy and practice issues in the Nepalese context. To conduct studies included in the Thesis, a HDSS was established in a peri-urban community near Kathmandu, the capital city (Paper I). Next, I explored KAP/behavior components of cardiovascular health in the community through a population-based survey (Paper II). Physical inactivity (Paper III) and low fruit and vegetable intake (Paper IV) were assessed as two examples of lifestyle-related behavioral risk factors. Finally, I explored cardiovascular health issues from patients’ perspectives through in-depth interviews (Paper V).

Epidemiological perspectives

By studying the burden of risk factors in a peri-urban community, this Thesis documents Nepal’s cardiovascular health status during a rural-to-urban transition. With particular emphasis on behavioral risk factors such as physical activity, my Thesis explores the distribution of cardiovascular risk according to different sociodemographic correlates in the study population. In addition, it investigates psychosocial determinants of cardiovascular health behavior in the community, paving the way for future health promotional and other interventional studies.

Urbanization as a driving force behind behavioral changes

Although urbanization is a central theme of this Thesis, I made no attempt to study urbanization as a separate variable or to quantify its level (118). Similar to studies from Pakistan, Egypt, and Iran, this Thesis simply acknowledges the urbanization process as an overarching theme that has been postulated as a driver of NCD in the community (119). Because of its absence as a tangible variable in my Thesis, I cannot claim epidemiologically that urbanization is
responsible or associated with the observed risk factor burden. Despite this crucial limitation, the study findings allow comparison of the risk factor burden in the rural-urban spectrum of Nepal (Figure 16).

**Figure 16:** Prevalence (%) of NCD risk factors in the JD-HDSS population compared with other Nepalese populations. Figures are based on WHO-STEPS surveys done in 2003 in an urban area of the Kathmandu district (120), in a rural area of the mountainous district of Ilam in 2006 (121), and a national representative sample in 2007-2008 (44). Urban slum data is based on a survey conducted in 2012 in the Sinamangal slum area of Kathmandu (122). All surveys have defined risk factors according to instructions for the WHO-STEPS Non-Communicable Disease Risk Factor Survey (80).

The urban population of the Kathmandu Valley has a high burden of risk factors (44), particularly among the urban poor (122). The urbanizing population of JD-HDSS has many of the risk factors that approximate the high urban
figures, particularly biological risk factors such as increased blood pressure and body weight. However, the urban Kathmandu study was conducted about eight years before the present study in peri-urban JD-HDSS. Therefore, the proximity of prevalence rates of the risk factors in the two areas may be considered an overestimation as the current urban prevalences are likely to be even higher.

Although data like these demonstrate ongoing efforts to obtain regular data on risk factors at national and sub-national levels, data on urbanization trends in Nepal is also available. At the national level, Nepal is urbanizing at an annual rate of 3.62% (123); however, there are intra-country disparities (124). For example, the capital Kathmandu, which contained 82% of Nepal’s urban population in 1950s, had only 31% of that share by 2001 (124). Also, the rate of urbanization is accelerating in newer areas. For example, while urbanization in Kathmandu rose from 55% to 65% between 1981 and 2001, the corresponding increase almost doubled (from 30% to 53%) in the neighboring Bhaktapur district, where JD-HDSS is located (124). Therefore, while some data describe the ongoing urbanization process in Nepal, there is a need for studies that couple urbanization trends with the changing status of behavioral risk factors to provide a better estimate of their association (118, 125, 126).

Physical inactivity and obesity as outcomes of changing population lifestyle

Physical inactivity in JD-HDSS (43%), a peri-urban area in Kathmandu Valley, is higher than the mountainous rural area of Ilam (35%), but currently less than prevalence in urban Kathmandu (82.3%) (Figure 16). Although this Thesis lacks a stringent measure of association, the comparative data does hint at a positive relationship between urbanization and physical inactivity, an association that has been observed in different settings, including China (127) and Israel (128). Also, the finding that most physical activity currently derives from work activities is a matter of concern (Paper III) because this domain of physical activity will invariably decrease in the future as more and more jobs become sedentary or
mechanized (127, 129). For example, the percent of people involved in farming in Nepal has decreased (from 94% to 65%) in the last three decades (130). Unless adequate physical activity is compensated through leisure and travel activities, the overall level of physical activity in the Nepalese population will drop significantly in the future.

Possibly in parallel to the level of low physical activity mentioned above, increased body mass index also follows the urbanization trend in Nepal (13). The relationship between overweight/obesity and physical activity is complex, often forming a vicious cycle of reduced physical activity that leads to increased body weight and vice versa (131).

**Sociodemographic disparities in risk factor prevalence**

This Thesis explored cardiovascular risk factors through the lens of various sociodemographic subsets of the study population. Although males’ lower prevalence of physical inactivity and obesity is similar to nationally representative data (44), they showed a higher prevalence of tobacco and alcohol consumption (Paper II). Females consumed more fruits and vegetables than males, but most did not attain the WHO recommendations (Paper IV). In terms of age, elderly people had lower cardiovascular health knowledge and physical activity, but increasing age did not affect fruit and vegetable intake (Papers II and IV). Ethnicity had no influence on perception or practice about heart disease. On the other hand, higher level of education associated with decreased prevalence of tobacco and alcohol consumption and improved fruit and vegetable intake, but concurrently with higher prevalence of physical inactivity and hypertension. These findings are important from epidemiological viewpoint because they help identify individuals who are at higher risk for any given risk factor.
HDSS as a setting for studying cardiovascular health

Similar to other HDSSs in various LMICs (65,132,133), JD-HDSS provided an appropriate platform for cardiovascular health studies in Nepal. Conducted in 2010, my initial survey provided up-to-date data about the study population as well as sampling frames for subsequent studies (Paper I). It also determined that CVDs are major causes of morbidity and mortality, validating the public health importance of cardiovascular studies in the community. Because the community is undergoing rapid urbanization, JD-HDSS provided an excellent opportunity to capture various sociodemographic aspects of CVDs in the changing Nepalese context. Establishment of the HDSS itself, however, was a challenge in terms of administrative hurdles, undue political influences, and other logistic difficulties (Paper I). Endorsement of the surveillance site by local collaborators, including the local administration and the partnering medical institutes, is another key issue for its long-term sustainability.

With the data of this Thesis as a baseline, longitudinal studies using the WHO-STEPS Non-Communicable Disease Risk Factors Survey can provide trends of risk factors in the population (134). However, there are many potential operational challenges (e.g., field monitoring) (135) and issues (e.g., incomplete data) (136). In addition, JD-HDSS has the necessary infrastructure and manpower to conduct community-based interventions that target single or multiple risk factors in its population sub-sets (137). It will be interesting to see whether such interventions can be generalized to a wider population base in other parts of Nepal. Although observational or interventional studies from an HDSS can provide useful epidemiological data, they cannot replace the need for routine monitoring and a surveillance system of cardiovascular health indicators, including morbidity and mortality data (138).
Learning points for cardiovascular health promotion in Nepal

Findings of this Thesis provide important learning points to better understand the cardiovascular health behavior of the study population. Because all stakeholders in a population aim to achieve healthy behavior (139), the factors that affect and influence health behavior are vital information for health promotion activities (140). Health promotion aims to invent, introduce, or improvise practices that improve public health (139). Particularly for NCDs, where many causes and solutions lie outside the walls of clinical medicine and often in human behavior, health promotion, with its emphasis on social action, is undoubtedly a logical partner to disease-oriented specialists (140). In resource-constrained settings like Nepal, health promotion is even more relevant and rational (53, 141).

The health promotion implications of this Thesis can be better comprehended by first considering its basic constructs, knowledge and attitude, and behavior/practice. This facilitates discussion of the findings through the lens of health literacy. A brief account of the different approaches of health promotion provides the premise to argue in support of health promotional activities in Nepal.

**Limited health knowledge**

Most often, knowledge alone is viewed as the most important determinant of health behavior. However, health promotional activities based solely on this assumption do not always lead to encouraging outcomes (142, 143).

Despite the high burden of risk factors, the study population’s cardiovascular health knowledge was limited regarding heart diseases, even among diseased individuals (Papers II and V). Cigarette smoking and excessive alcohol consumption were spontaneously linked to heart diseases by the general population and patients alike, a finding that has been reported in other settings as
well (91, 95). However, physical inactivity and inadequate fruit and vegetable intake were not usually seen as important determinants of heart disease.

Attitude including perceived locus of control is a key factor
Like knowledge, attitude is an often-explored construct (144, 145). A majority of our respondents underestimated their cardiovascular risk and did not want to modify their adverse lifestyles despite having adequate knowledge about risk factors (Paper II). Hence, this Thesis incriminates the attitude of the study population as an important bottleneck toward heart-healthy behavior.

Another attitude-related finding of this Thesis is about locus of control. Health locus of control is the expectation of individuals regarding the effects of their behavior on their health (146, 147). Due to a strong conviction among respondents that their health is determined by a higher power (i.e., “chance externality”), the locus is external in our study population. When respondents become ill, the locus shifts toward doctors or medical professionals (i.e., “powerful others externality”). In fact, previous studies have shown that individuals who believe that their health status depends on their personal decisions and behaviors (i.e., “internality”) show better mastery of their health situation (148).

Delayed attempts at modifying cardiovascular health behavior
Because health behavior is not a linear phenomenon (149), it cannot be explained with knowledge and attitude perspectives alone (150). Hence, although this Thesis begins by exploring both of these constructs in relation to cardiovascular health behavior and practice in the community (Paper II), it quickly expands to include other constructs of health behavior, especially after triangulation at the interpretation level described in the qualitative study (Paper V).

Lifestyle modification is an important health behavioral act (151, 152), and many respondents changed their lifestyles after they developed disease
(Paper V). Because they did not consider themselves at risk before the overt manifestation of disease, they had been reluctant to make any behavioral modification. Different theories of health behavior help explain a situation like this (66). For example, perceived susceptibility (as explained in the health belief model) and attitude that leads to intention toward heart-healthy behavior (as explained by the Theory of Reasoned Action) are important determinants of cardiovascular health behavior in the study population (66). In addition, personal cognitive factors such as outcome expectations, rewards received and emotional coping (as explained by Social Cognitive Theory), also affect practice and behavior (68). However, respondents did not emphasize the third component of the triad (i.e., environment). For example, they did not link inadequate physical activity with unavailability of walkable pavements, playgrounds, and parks in their community (20). This may be due to less emphasis on physical inactivity and ignorance about the effect of environmental factors on physical activity.

Inadequate health literacy

Often labeled as a repackaging of health education and health promotion strategies, health literacy is commonly viewed as a bridging concept between knowledge and practice (140). Basically, it has been conceptualized as the skills that an individual possesses to translate his/her health knowledge into health practice (153). Three levels of health literacy have been described: functional (basic reading and writing skills to understand and follow simple health messages); interactive (cognitive and interpersonal skills to manage health in partnership with professionals); and critical (ability to analyze information critically, increase awareness, and participate in action to address barriers) (154).

Secondary and tertiary care settings often evaluate patients’ health literacy with tools that assess reading fluency regarding health-related print and oral literacy (153). In a primary or preventive care facility, the assessment of health literacy is less well-defined and still evolving (28, 154). Hence, this Thesis did
not assess health literacy with any particular tool, but rather used the concept broadly to describe a person’s ability to utilize the health knowledge that he/she has.

If lifestyle modification is a crucial outcome of health behavior, the community lacks adequate health literacy at all three levels. The first level (i.e., functional health literacy) may be lacking due not only to the community’s inability to comprehend heart-healthy messages but also because the community lacks suitable resources for such messages (153). In fact, when asked to rate how well they were informed about cardiovascular health issues, 43% of the respondents acknowledged that they were not informed at all (unpublished data). Among those who said they were informed, media was the source of information for half of them; only 14% had ever received any cardiovascular health information from a health worker. Similarly, the community’s sub-optimal interactive health literacy is exemplified by patients’ complete dependency on doctors for disease management (Papers II and V). Further, lack of any regular health promotional programs and cardiovascular primary care virtually rules out the scope to even assess critical health literacy. Thus, improving the cardiovascular health literacy of this community requires attempts not only to improve an individual’s psychosocial factors that increase functional and interactive health literacy, but also to encourage an environment that fosters critical health literacy (155).

**Dominance of the medical approach to health promotion in Nepal**

There are five different approaches to health promotion (156, 157). The medical, or preventive, approach targets entire populations or high-risk groups. It has three levels of intervention (primary, secondary, and tertiary) and is popular because it is expert-driven. The behavior change approach, which encourages individuals to adopt healthy behaviors, is considered the bedrock of health promotional activities. It is complex due to the multi-dimensional interactions of
human behavior with social and environmental factors. The third method is the educational approach, which provides knowledge and information that enable people to make informed choices about their health behavior but does not aim to persuade or motivate change in a particular way. This approach assumes that increased knowledge will automatically lead to positive changes in attitude that will, in turn, promote healthy behavior. On the other hand, the empowerment approach is client-centric and requires practitioners to use their own power to help clients get power. The fifth approach, called the social change approach, is more radical, and encompasses policy and environmental dimensions of health promotion.

Nepal’s current strategy for tackling NCDs is based largely on the medical model (i.e., treatment), which receives much greater attention, investment, and importance than other forms of health promotion (43). This approach is entirely top-down, and the patient-healer equation is diametrically opposite to what one expects in the empowerment approach. Such equations are better explored with explanatory models that look at both patient and provider perspectives (158). Although this Thesis did not use explanatory models, information based on patients’ perspectives does illustrate the aforementioned remarks that cardiovascular health promotion occurs mostly through a provider-centric medical approach, focused disproportionately on curative strategies and practiced more often at secondary and tertiary levels.

Health promotion as a starting point of primary cardiovascular care in Nepal

The findings in this Thesis reinforce my earlier viewpoint that the practice of health promotion in Nepal should expand beyond the hospital walls and focus instead on primary care settings (141). Inadequate health knowledge and literacy, adverse attitudes, and the high burden of behavioral and biological risk factors in the community all point toward a need for community-oriented activities for cardiovascular health promotion. Thus, cardiovascular health and
other NCDs should be part of primary health care in Nepal. Nepal has a well-established primary healthcare system (41) that practices varying degrees of different health promotional approaches, mainly for maternal and children’s health problems (159–161) but also for newer areas like oral health (162). The feasibility of broadening such community-level health promotional activities to include cardiovascular and other NCD components requires exploration. Additionally, primary health care must be upgraded at the grass roots level, and primary care health workers must be re-oriented to NCD-related health promotion activities (23). Nonetheless, in addition to the general recommendations for all major risk factors, health promotion activities must consider the local risk factor burden and behavior gaps. For example, the JD-HDSS community must prioritize physical activity, tobacco consumption, and fruit and vegetable intake. Similarly, strategies that improve attitude would add an important component to health promotion in this population (163).

**Implications for health policy in Nepal**

Nepal’s current National Health Policy dates to 1991 (164). Riding the aspirations of newly achieved democracy, this landmark document provided a framework to guide health sector development in Nepal and emphasized rural health. It focused mainly on issues pertaining to maternal and child health and communicable diseases.

Nepal’s National Health Policy 1991 stood on a tripod of preventive, promotive, and curative health services (164). In retrospect, preventive services did remarkably well, particularly in reducing childhood mortality. The success of curative services was moderate, but with influx of private sector and urban-centric treatment facilities, health inequity has actually widened in the last decade or so (165). However, the promotive component, which aimed to motivate healthy behavior in the population, was not really successful, mainly due to lower priority (166).
Since 1991, Nepal has witnessed further political upheaval, sociodemographic transformations, and a changing mosaic of health problems (42). The existing health policy could not address newer health issues (e.g., urban health, NCDs, international and global health), and recent efforts have sought to revise the policy (167). Currently, NCDs are an important addition in the ongoing revised health policy draft (168).

This Thesis was not based on health policy research and did not investigate health policy issues pertaining to cardiovascular health. However, some of its findings are relevant to health policy. First, the NCD section of the draft health policy gives adequate importance to health promotion (168), and the study findings described in this Thesis reaffirm that emphasis. Second, the draft policy aims to ensure that NCD services trickle down from super-specialty to primary care outlets such as health posts. This Thesis also indicates the need and relevancy of that strategy. For example, only 20% of respondents with cardiometabolic diseases visited nearby health posts. While 35% had to visit hospitals and private clinics in the city and another 20% received medicines directly from pharmacy shops, 14% and 11% did home-based therapies or consulted traditional healers, respectively (unpublished data). Third, the draft policy underscores the necessity of population-based monitoring and surveillance of NCD-related indicators, including risk factor trends. Using an HDSS setting, this Thesis demonstrates the possibility and potential of obtaining quality data on risk factor trends and other sociomedical aspects of CVDs, including cardiovascular health literacy, practice, and behavior.

Lack of an appropriate health policy that addresses cardiovascular health issues is a known barrier to achieving cardiovascular health goals (169, 170). Further, health policy should be evidence-based (171). Hence, in the context of Nepal, swift enactment of the revised health policy is crucial, as is fair evaluation of its implementation.
Relevance of the study findings to other low- and middle-income countries

Although generalization of the Thesis findings should be done with caution, the epidemiological situation in Nepal is in many ways typical of that in many other LMICs (172, 173). The common threads in most LMICs are high burden of NCD morbidity and mortality (174); inadequate local research and data on the NCD burden (172), including intervention trials (171); and lack of financial, technical, and manpower resources to tackle NCDs (175, 176). Compared to the earlier epidemiological transition in high-income nations, the ongoing transition in Nepal and other LMICs differ sociodemographically in terms of a rapidly aging population, urbanization patterns, and rural out-migrations (171). In addition, unlike high-income nations, NCD-related risk estimation in LMICs goes beyond clinical (175) and biochemical risk factor profiling, and the social and cultural context of health behavioral patterns is more important (171). Nevertheless, even among the LMICs, differences are inevitable in terms of sociodemographic structures, differential prevalence of risk factors, and health systems (171, 175).

Despite inter-country variations, contextual similarities allow the usefulness of research findings across LMICs (176). For example, studies from other LMICs echo the findings of low cardiovascular health literacy presented in this Thesis (177). Likewise, the qualitative study findings of patients’ perceptions presented here would be relevant in other similar settings. On the other hand, findings of interventional studies from other LMICs will provide useful learning lessons for JD-HDSS and Nepal (177–179).
CONCLUSIONS

This Thesis adds new dimensions to population-based cardiovascular health research in Nepal. In a setting where cardiovascular health research has traditionally been limited to the estimation of risk factor burden, the findings presented here widen the research arena by encompassing psychosocial aspects of cardiovascular health and investigating links between cardiovascular health knowledge, attitude, literacy, and behavior. Similarly, this Thesis provides a deeper exploration of the sociodemographic aspects of behavioral risk factors (e.g., physical activity and fruit and vegetable consumption).

Study findings reconfirm the rising burden of CVD risk factors in a low-income country like Nepal, and also expose population-level barriers for achieving better cardiovascular health status. For example, lack of adequate cardiovascular health literacy in the study population potentially hinders implementation of any public health effort. Indeed, the major bottlenecks in achieving better cardiovascular health literacy in this population include insufficient knowledge, adverse attitudinal attributes, and lack of application of evidence-based health promotional activities at all levels of care.

This Thesis highlights the major challenges for cardiovascular health at the population level, and also provides useful information for public health practice. First, although the findings reported here pertain to the Nepalese context, the inference from the studies can be relevant for similar communities, both in Nepal and in other LMICs. Second, although the studies employ internationally validated questionnaires and guidelines, they also include local anthropological and cultural constructs. Thus, the study findings present a holistic situational analysis of cardiovascular health in Nepal from the population perspective. Therefore, solutions based on these local findings are more likely to work. Third, the use of health behavior theories helps untangle the
most important determinants of cardiovascular health behavior, thus offering opportunities to formulate locally tailored health promotion strategies. Finally, the patients’ narrations of their experiences and dilemmas surrounding lifestyle modifications demonstrate the potential of better cardiovascular health care at the community level.
FUTURE PERSPECTIVES

By uncovering the gaps in cardiovascular health literacy and practice, this Thesis underscores the need for cardiovascular health promotion at the community level. Instead of a one-size-fits-all strategy, health promotional activities should target different subgroups of population with appropriate strategies. For this, future studies should also explore cardiovascular health issues in specific groups (e.g., children and adolescents).

Further studies on behavioral risk factors (e.g., physical activity) should incorporate ecological and environmental attributes. Controlling diet-related risk factors will require greater in-depth analysis of psychosocial characteristics such as eating habits. Ethnographic approaches will increase our ability to explore cultural and other social aspects of cardiovascular health behavior.

Appropriate study designs, such as longitudinal studies in the current JD-HDSS setting, should document how urbanization affects risk factor trends. Finally, research that investigates the perspectives of healthcare providers, policy-makers, and other stakeholders can form a more comprehensive picture of the current cardiovascular health situation of Nepal.
ACKNOWLEDGMENTS
Professor Alexandra Krettek: my supervisor. I did not know that the term SUPERvisor was coined for her! I have now known Alexandra for five years and seven months, and ironically, I have never felt that she is like is a supervisor. Instead, she has been a friend, philosopher and guide, and more. With a brilliant blend of scientific knowledge, management skills, and superlative humanity, she has been an inspiring person, a motherly figure, a strict teacher, and an exceptional host. In fact, her home is my address in Sweden. With her around, I feel nothing is impossible. She makes things happen. I must have been born lucky to have a supervisor like her. Thank you, Alexandra, for everything. This work would not have been possible without you. Period. I shall miss you in this role, but I know that we still have a long way to go together as we pursue our common endeavors.

As an endless source of inspiration, I owe a lot to Professor Emeritus Bo Eriksson, Nordic School of Public Health NHV. I still remember him saying this to me regarding implementation of my research plan: “You have thought about this for too long, Abhinav. Now, it’s time to actually do it.” In addition, I acknowledge the historic contribution of Professor Göran Bondjers in establishing academic ties between Sweden and Nepal. I also thank Professor Max Petzold for his contribution for the JD-HDSS project in Nepal, and for being there whenever we needed his guidance and support. I am also absolutely indebted to my co-supervisor, Professor Göran Bergström, for coming into the picture at a very critical juncture of my PhD.

Professor Dambar Bahadur Karki, who is Head of the Department of Internal Medicine, Kathmandu Medical College, and my mentor, has been a father figure to me. He often conveyed his unwavering faith in me and my work through his gentle eyes, firm handshakes, and tender pats on the back. I thank you, sir. Aside from Professor Karki, two other prominent cardiologists who are equally devoted to cardiovascular epidemiology and cardiovascular health
promotion in Nepal, and with whom I have the good fortune of working closely, have substantially influenced my career path. I thank you, Dr. Bharat Rawat and Dr. Mrigendra Raj Pandey, for your wit, words of wisdom, and good wishes.

It was the quartet of Suraj Shakya Vaidya, Umesh Raj Aryal, Muni Raj Chhetri, and me that worked as a local managing committee to establish the JD-HDSS in Nepal and carry out further studies. Pooling together our individual strengths and skills, our teamwork could weather the plethora of challenges, including those encountered during fieldwork, and achieve our research goals. I thank you all for being there for the project and for me. Special thanks to Umesh for being my research partner and for standing by me, particularly during difficult times. And now I am happy to welcome Natalia Oli to our JD-HDSS team, and I thank her for her thoughtful insights. Her passion to do something good for cardiovascular health issues of children has always been infectious and inspirational.

Many people have worked hard behind the scenes to ensure quality data. I thank my field supervisors, Vishal Bhandari, Ranjan Kapali, Rachana Shrestha, Chandra Shova Khaitu, and Shova Poudel, for their untiring enthusiasm. Face-to-face interviewing is not an easy job, particularly when you have to walk for miles on uneven terrains to cover widely separated houses. This daunting task was well-handled by our spirited team of enumerators. I also thank Mirak Angdembe and his team for managing the data entry procedure in a most professional way. Similarly, Amit and Bhavana Mishra were incredible during the qualitative study. But above all, I thank all the study participants for their contribution in making the studies possible. Additionally, I acknowledge the cooperation extended by community leaders, health post in-charges Mr. Dil Kumar Duwal and Mr. Yam Bahadur Darlami, and the staff of Duwakot and Jhaukhel.

Two Nepalese medical institutes, Kathmandu Medical College and Nepal Medical College, collaborated on the JD-HDSS project. I thank Professor
Shekhar Babu Rizyal, Dr. Shyam Prasad Bhattarai, Dr. Aparna Rizyal, and the management of Nepal Medical College for their support, including sheltering the JD-HDSS office on the premises of Nepal Medical College Community Hospital at Jhaukhel. I must thank Staff Nurse Bishnu Subedi and other staff there for their warm and welcoming hospitality during the training sessions. I am also thankful to Muna Aryal for going out of her way to extend logistic support every time we needed her.

My institute, Kathmandu Medical College, has stood behind me throughout my PhD work. I am grateful to my CEO Professor Govind Prasad Sharma, former Principal Professor Hemang Dixit, former Campus Chief Professor Bisharad Man Shrestha, and Principal Professor Chanda Karki for their support and words of encouragement. I also thank Dr. Binita Pradhan and the staff of Kathmandu Medical College Community Hospital, Duwakot, for their cooperation. My department of Community Medicine, Kathmandu Medical College has borne the brunt of my PhD work, which seemed never-ending (five years, to be precise). I heartily thank my department head Professor Indur Dudani and other faculty members, and my post-graduate students for their cooperation and tolerance with my periodic absences and, worse still, my demands, tantrums, and irritability. At Kathmandu Medical College, I also thank my friends and senior faculty in the clinical departments for taking care of my endless health issues. Here, I also thank everyone at Norvic International Hospital for ensuring that my heart went on!

Qualitative study was never my cup of tea. In fact, I never even thought of it as a cup or as tea! I thank Associate Professor Lene Povlsen of the Nordic School of Public Health NHV for changing me and helping me understand the importance of qualitative studies in health sciences. And, thank you Associate Professor Madhusudan Subedi, Patan Academy of Health Sciences, for reaffirming that the change had indeed taken place.
Speaking of the Nordic School of Public Health NHV, I absolutely thank the school for everything: for all the courses and training it has given and for all the funds it has provided to facilitate my travel and other costs. Nordic School of Public Health NHV shall always remain special to me. I thank all the staff and faculty there, especially Josefin Bergenholtz, Susanne Tidblom-Kjellberger, Tanja Johansson, and Associate Professor Karolina Andersson Sundell, for their cooperation. I thank my fellow PhD students and friends Toan Tran Khanh, Nguyen Thu Huong, Ylva Bjereld, Susann Regber, Hildur Gunnarsdottir, Hanna Gyllensten, Katja Hakkarainen, Kristine Crondahl and Ruth Montgomery-Andersen, and not to forget, Suraj Shakya Vaidya and Umesh Raj Aryal.

Besides the Nordic School of Public Health NHV, I acknowledge the financial support provided by the Swedish Society of Medicine, Wilhelm and Martina Lundgren Foundation, Johan & Jacob Söderberg Foundation, and the “Global University” grant from the University of Gothenburg, Sweden. Further, I express my gratitude to everyone who helped enhance the scientific quality of my work, including my examiners, the journal editors and reviewers of my papers, and most importantly, the person who has been extremely supportive in editing my manuscripts, Karen Williams. Thank you, Karen, for making my English look so good!

All my love to my wife Prarthana who has seen me only studying, and that too often well into the wee hours, for eight of our ten years of married life, first, during my Masters, and then, during my PhD. Thank you, dear. Also, big ‘thank you’ hugs to my eight-year-old son Abhipraaya for being the most understanding son. Some three years ago, on seeing me working at home all the time, he once quipped, “I want to be a doctor like you when I grow up, so that I also get to work ... on a laptop!”

Speaking of family, I fondly remember my Swedish family members, who are absolutely wonderful human beings. Sven-Olof Jönsson, thank you for all the support, smiles, and, not to forget, your engineering skills that I often had to
Speaking of the Nordic School of Public Health NHV, I absolutely thank the school for everything: for all the courses and training it has given and for all the funds it has provided to facilitate my travel and other costs. Nordic School of Public Health NHV shall always remain special to me. I thank all the staff and faculty there, especially Josefin Bergenholtz, Susanne Tidblom-Kjellberger, Tanja Johansson, and Associate Professor Karolina Andersson Sundell, for their cooperation. I thank my fellow PhD students and friends Toan Tran Khanh, Nguyen Thu Huong, Ylva Bjereld, Susann Regber, Hildur Gunnarsdottir, Hanna Gyllensten, Katja Hakkarainen, Kristine Crondahl and Ruth Montgomery-Andersen, and not to forget, Suraj Shakya Vaidya and Umesh Raj Aryal.

Besides the Nordic School of Public Health NHV, I acknowledge the financial support provided by the Swedish Society of Medicine, Wilhelm and Martina Lundgren Foundation, Johan & Jacob Söderberg Foundation, and the “Global University” grant from the University of Gothenburg, Sweden. Further, I express my gratitude to everyone who helped enhance the scientific quality of my work, including my examiners, the journal editors and reviewers of my papers, and most importantly, the person who has been extremely supportive in editing my manuscripts, Karen Williams. Thank you, Karen, for making my English look so good!

All my love to my wife Prarthana who has seen me only studying, and that too often well into the wee hours, for eight of our ten years of married life, first, during my Masters, and then, during my PhD. Thank you, dear. Also, big 'thank you' hugs to my eight-year-old son Abhipraaya for being the most understanding son. Some three years ago, on seeing me working at home all the time, he once quipped, “I want to be a doctor like you when I grow up, so that I also get to work ... on a laptop!”

Speaking of family, I fondly remember my Swedish family members, who are absolutely wonderful human beings. Sven-Olof Jönsson, thank you for all the support, smiles, and, not to forget, your engineering skills that I often had to put into use. And for always making me feel at home away from home, I express my gratitude, love, and respect to the Krettek family, Detlef and Evaline and their daughter Alexandra!

Abhinav Vaidya,
Kathmandu, Nepal
April 5, 2014
REFERENCES


(20) Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW. Correlates of physical activity: why are some people physically active and others not? The Lancet 2012;380(9838):258-271.


(64) Pronyk PM, Kahn K, Tollman SM. Using health and demographic surveillance to understand the burden of disease in populations: The case of tuberculosis in rural South Africa. Scand J Public Health 2007;35:45-51.


(106) Johnson JS, Nobmann ED, Asay E. Factors related to fruit, vegetable and traditional food consumption which may affect health among Alaska Native People in Western Alaska. Int J Circumpolar Health 2012;71.

(107) Rose D, Richards R. Food store access and household fruit and vegetable use among participants in the US Food Stamp Program. Public Health Nutr 2004;7(08):1081-1088.


(116) Beya M. Lay beliefs of hypertensive patients attending Katleho District Hospital (KDH) in Virginia in Free State regarding their disease. Lay beliefs of hypertensive patients attending Katleho District Hospital (KDH) in Virginia in Free State regarding their disease (Master's thesis, University of Limpopo, 2010).


