Understanding the Social Determinants of Non-communicable Diseases in Nepal: A Systems Perspective

A thesis presented in the partial fulfilment of the requirements for the degree of

Doctor of Philosophy (PhD)

in

Health Sciences

at Massey University, Wellington Campus,

New Zealand

Sudesh Raj Sharma

2020

Abstract

Non-communicable diseases (NCDs) constitute more than half of the total disease burden in Nepal. Global evidence indicates the problem of NCDs is influenced by the complex interaction of social determinants including behavioural, socio-economic and environmental. These determinants are the focus of global prevention strategies for tackling NCDs. The health system of Nepal, however, is yet to adopt this comprehensive prevention strategies. The main objective of this research was to understand the social determinants of NCDs in Nepal and identify leverage points for systemic actions in Nepal.

The study utilized a systems thinking methodology which enabled a creative combination of case study methods and qualitative causal loop diagramming. In each of the two selected case districts (Bhaktapur and Morang), semi-structured interviews (n=39) and focus group discussions (n=12) were conducted with key stakeholders and community members. These case studies were informed by policy level interviews (n=24). Thematic analysis, guided by the adapted social determinants of health framework, helped to identify key themes and develop causal loop diagrams (CLDs). The findings of the thematic analysis, and CLDs, were then validated through local and policy sense-making workshops.

The analysis showed four key interlinked thematic areas, each of which is being published as separate papers. The first paper describes the community and stakeholders' perception and experience of the rising burden of NCDs. The social experience of NCDs metabolic risks such as hypertension and diabetes were shown to be normalised. Moreover, differences in social experience were observed based on gender and socio-

economic circumstances. The second paper described the critical role played by tobacco and alcohol in the interaction of social determinants of NCDs. The analysis indicates that socio-economic circumstances was root cause of changing, and damaging alcohol and tobacco practices, and increased the vulnerability to exploitation by industries. The third paper revealed that poor dietary practices and physical inactivity were resulting due to changes in social practices shaped by worsening dietary and physical environment. Socio-economic circumstances, urbanisation and migration all contributed to the population being exposed to an obesogenic environment. While all three papers discussed specific health system challenges, the fourth paper elaborated on health sector challenges, including the curative focus and limited capacity of the health system both at district and policy or national level to prevent NCDs in Nepal.

Three key leverage points for health system action on the social determinant of NCDs were identified by viewing the final CLD through the lens of Donella Meadows' framework for identifying key health system action on the social determinants of health. These leverage points indicated that the health sector should focus on the development of a robust prevention system for effective NCDs action.

Overall, the study highlighted the interactions of socio-economic, gender, commercial and health system determinants driving the NCDs problem in Nepal. The leverage analysis indicated that the health sector should focus on the development of a robust prevention system for effective action on complex problem like NCDs. The Ministry of Health could play a proactive role in creating the prevention system that could effectively guide all sectors towards collective action to impacting social and commercial determinants of health.

Acknowledgement

First, I would like to heartily acknowledge my research participants of the study without whom my study would not have been possible. I would like to whole heartedly thank the village and municipality level participants, including general public, teachers, health volunteers, health workers and local leaders, for their understanding and participation. I would like to thank district and policy level participants who participated in my study as key informants and/or workshop participants.

I am indebted to Dr. Dipendra Raman Singh, Ms. Yashoda Aryal and Mr. Bhim Prasad Sapkota from the Ministry of Health for providing necessary support relating to this research from both organisational and personal levels. I would also like to thank Mr. Chudamani Bhandari from the Department of Health Services who wholeheartedly supported me during the study. I would like to acknowledge Mr. Ram Bhandari, Dr. Amod Poudyal, Dr. Bharatmani Devkota and Dr. Madhu Dixit Devkota, all of whom have greatly shaped my academic and professional career and enabled me to be in this capacity for doing my PhD.

I am fortunate to have a very supportive supervisory panel who have wholeheartedly supported me during the PhD and its ups and downs. Their unwavering support and in the process providing timely feedback is something I am fortunate to have. I would like to acknowledge Massey-based primary supervisors Rachel Page and Anna Matheson who both were supportive and critical of my work and were instrumental in shaping my PhD, especially during the first year. Thank you, Anna, for introducing me to the systems thinking approach and providing valuable conceptual clarity and guidance in shaping the methodology of my thesis. Rachel, as always, is critical and devoted to

academic rigour (e.g. how does this link back to your research questions?). Danielle Lambrick (University of Southampton) and James Faulkner (University of Winchester) have always provided great feedback despite the physical distance and their added responsibility of parenting. I would especially like to thank David Lounsbury from Albert Einstein College of Medicine who was always there to provide me with feedback, especially in improving causal loop model and archetypes. I will be always thankful to him for his Sunday morning (New Zealand time) zoom meetings with me and giving up his Saturday evenings (US time). Thank you so much, Dr. Abhinav Vaidya, for your critical feedback and encouragement as always.

I thank all my friends in Nepal and abroad who have helped me directly or indirectly get here; special mentions to Binayak, Suman, Adrian, Paul, Manish, Deepak, Krishna Man, Bhuwan, Kapil, Resham, Shiva, Mukesh, Mohan, Adarsha and Yadu.

I would like to thank my parents, brother, sister-in-law and relatives who have supported my every academic and professional endeavours. Thank you for your patience and support.

Last but not the least, I would like to acknowledge my wife Neetu who is the bedrock of my family and without her support this PhD journey would not have been possible. Her support during the entire PhD studies and looking after our two munchkins Sammy and Nevaan are irreplaceable. I know that Neetu, Sammy and Nevaan all have missed out on a lot of adventures and family time due to PhD studies. I will make up for that after my PhD. Thank you.

Table of Contents

Abstract ..... **i**

Acknowledgement ..... **iii**

List of figures ..... **vii**

List of tables ..... **viii**

List of acronyms ..... **ix**

Chapter I: Introduction **1**

1.1 The growing burden of NCDs in low-income countries 2

1.2 Nepal's struggle to prevent NCDs 2

1.3 Historical development of Nepal's health system 4

1.4 Framing NCDs from SDH perspective 7

1.5 Rationale for the current thesis 9

1.6 Thesis research questions and objectives 10

1.7 Scope of the thesis 11

1.8 Outline of the thesis 11

Chapter II: Literature review **15**

2.1 Metabolic risk factors and NCDs 16

2.2 Intermediary determinants of NCDs and metabolic risks 17

2.3 Structural determinants of NCDs and metabolic risks 20

2.4 Knowledge and research gaps 26

Chapter III: Methodology and method **29**

3.1 Systems thinking approach for SDH research 30

3.2 The adapted WHO framework to guide the PhD study 31

3.3 Systemic intervention methodology 33

3.4 Method 36

Chapter IV: Results **51**

Paper 1: Individual and community experience of rising burden of non-communicable diseases in two case districts of Nepal: a qualitative exploration 52

Paper 2: “Tobacco and alcohol use are playing critical role in the interaction of social determinants of non-communicable diseases in Nepal”: a systems perspective 69

Paper 3: The role of dietary practices and physical activity in the interaction of social determinants of non-communicable diseases in Nepal: a systemic analysis 105

Paper 4: Health and social system challenges to tackle social determinants of NCDs in Nepal: a systemic analysis 139

Chapter V: Discussion **157**

5.1 Background 158

5.2 Reflection on the application of systemic intervention approach 159

5.3 Reflecting on the social determinants of NCDs 163

5.5 Limitations of the study 178

Chapter VI: Implications, Recommendations and Conclusion **181**

6.1 Improving the health system of Nepal 182

6.2 Recommendations 184

6.3 Conclusion 189

References **193**

Appendices **217**

List of figures

Figure 1. Primary healthcare delivery system of Nepal 6
Figure 2. Social determinants of health framework proposed by the World Health Organization 8
Figure 3. Study Framework for PhD project adapted from the SDH framework of the WHO 32
Figure 4. Methodological framework of the study 34
Figure 5. Outline of systemic intervention research design 37
Figure 6. Map of Nepal and study area highlighted 40
Figure 7. Linkages of the four results papers of this study 46
Figure 8. Meadows' twelve leverage points and four system characteristics (176) 48
Figure 9. Prevention delay sub-system showing the interaction of governmental response to prevent tobacco and alcohol use, other sub-systems and NCDs 90
Figure 10. Demand-supply sub-system showing the interaction of availability and sales of tobacco/alcohol, other sub-systems and NCDs 91
Figure 11. Socio-economic influence sub-system showing the interaction of socio-economic status, other sub-systems for tobacco and alcohol use and NCDs 92
Figure 12. System archetypes showing different mechanisms of influence of tobacco and alcohol use on NCDs 100
Figure 13. Prevention delay sub-system showing the interaction of governmental response to promote healthy diet and physical activity, other sub-systems and NCDs 125
Figure 14. Demand-supply sub-system showing the interaction of availability and sales of junk food, other sub-systems and NCDs 126
Figure 15. Socio-economic influence sub-system showing the interaction of socio-economic status, other sub-systems for dietary and physical activity practices and NCDs 127
Figure 16. System archetypes showing different mechanisms of influence of dietary and physical activity practices on NCDs 128
Figure 17. Final CLD of the interacting social determinants of NCDs in Nepal 151
Figure 18. Final CLD showing leverage points for systemic action on NCDs in Nepal 170
Figure 19. Recommended prevention system framework to tackle social determinants of NCDs in Nepal 188

List of tables

Table 1. *Percentage prevalence of key metabolic risk factors of NCDs in Nepal in 2007 and 2013*.....3
Table 2. *Percentage prevalence of key behavioural risk factors of NCDs in Nepal in 2007 and 2013*.....3
Table 3. *Participants, key characteristics, sample size and data collection techniques and tools*.....42
Table 4. *Description of the framework approach steps followed during the research*...44

List of acronyms

BMI	Body Mass Index
CHWs	Community Health workers
CLD	Causal Loop Diagram
CRDs	Chronic Respiratory Diseases
CVDs	Cardiovascular diseases
D(P)HO	District (Public) Health Office
FCHVs	Female Community Health Volunteers
FGD	Focus group discussion
HIC	High-income countries
I/NGO	International/Non-government organisations
KII	Key Informant Interview
LMIC	Low- and middle-income countries
MCH	Maternal and Child Health
MDG	Millennium Development Goal
NCDs	Non-communicable diseases
PEN	Package of essential non-communicable disease interventions
PHC	Primary Health Care
SD	System Dynamics

SDH	Social Determinants of health
SDG	Sustainable Development Goal
SI	Systemic intervention
SPHC	Selective Primary Health Care
UNICEF	United Nations Children's Fund
STEPS	Step-wise approach to surveillance
VDCs	Village Development Committees
WHO	World Health Organization

Chapter I: Introduction

In this introductory chapter, the issue of non-communicable diseases (NCDs) and their metabolic risks in low- and middle-income countries (LMIC) like Nepal is briefly examined and the struggles of the health system in Nepal in the prevention of NCDs and their risks are discussed. A brief background of the historical development of the health system of Nepal is then presented to further illustrate the health system context. A social determinant of health concept with a system thinking approach is utilised to facilitate understanding of the complex issues of NCDs. This chapter then presents the rationale, aim and objectives of the thesis based on the background information discussed. Finally, an outline of the structure of this thesis is presented to provide an overview of the thesis contents with the understanding that this PhD study is being presented as a thesis by publication.

1.1 The growing burden of NCDs in low-income countries

Non-communicable diseases (NCDs) are a global problem rapidly gripping this world in epidemic form with serious health, social and economic consequences mostly affecting low-income groups (1-4). NCDs consist of a range of diseases, including cardiovascular diseases (CVDs), diabetes, chronic respiratory diseases (CRDs), cancers, and mental health problems. As a global health agenda, four diseases (CVDs, diabetes, CRDs and cancer) have been prioritised by the World Health Organization (WHO) due to their magnitude and common risk factors. NCDs, primarily the four diseases, accounted for 68% of NCDs-related deaths globally in 2012 with about 40% of those deaths being premature, and more than 80% of the global premature deaths occurred in LMIC (3).

The South East Asia region of WHO carries a significant burden of NCDs' related mortality with the highest increment in the deaths among all regions from 2000 to 2012 (3). In 2012 alone, there were 8.5 million deaths in South East Asia region. Similarly, at the age of 30, an adult in the region has a 25 percent chance of dying from one of the four NCDs before the age of 70. The challenge of addressing NCDs is complex due to the multi-level factors and issues that are driving the epidemic (4-6).

1.2 Nepal's struggle to prevent NCDs

In Nepal, more than half of the disease burden is due to NCDs (7, 8). The major NCDs in Nepal are CVDs, CRDs, cancers, diabetes, injuries and mental health (neuropsychiatric conditions), with CVDs alone contributing to about 20% of the total burden (7-9). The rapid increase in NCDs can be strongly linked with increasing prevalence of metabolic risks such as high blood pressure, high blood cholesterol, high

blood glucose and overweight/obesity in Nepal (table 1) (10, 11), which is similar to other low-income nations (12).

Table 1. *Percentage prevalence of key metabolic risk factors of NCDs in Nepal in 2007 and 2013*

Survey Year	**Prevalence of metabolic risks**			
	Hypertension	***High sugar***	***High BMI***	***High cholesterol***
2007	21.5	-	7.2	-
2013	25.7	7.7	21.6	22.7

National surveys have also identified the key behavioural risk factors responsible for the NCDs. The common behavioural risk factors such as tobacco use, alcohol consumption, limited physical activity and poor dietary habit were widely prevalent in Nepal according to the national surveys (table 2).

Table 2. *Percentage prevalence of key behavioural risk factors of NCDs in Nepal in 2007 and 2013*

Survey Year	**Prevalence of behavioural risks**			
	Smoking	***Alcohol Use***	***Low Physical Activity***	***Less Fruits and Vegetables***
2007	23.8	28.5	5.5	61.9
2013	18.5	17.4	3.5	98.9

Though the trend is decreasing for most of the behavioural risk factors (except fruit and vegetable consumption), the prevalence is high for all risk factors. A decrease in these factors may be attributed to global advocacy and related actions; however a continuation of this apparent trend will be linked to the quality of efforts on the part of the public

health system in Nepal. The current focus of the health system in Nepal is more focused on providing medical care for treatment and control of NCDs instead of prevention of risk factors of NCDs. Further, the limited prevention action on NCDs has not moved beyond the behavioural factors and taken other multi-level factors into account. The Nepalese health system is primarily focused on tackling maternal and child health (MCH) issues, and communicable diseases, for example those that may cause diarrhoea and pneumonia, hence the fundamental way that it is structured, and its functions are not conducive to NCDs prevention.

LMIC like Nepal have a weaker capacity to deal with the challenges of preventing NCDs and are more vulnerable to the effects of NCDs (3, 4). A detailed discussion on the challenges of NCDs prevention in Nepal has been published as a commentary (13) and is included in appendix I. The below section describes the historical development of the health system of Nepal to further illuminate the context of NCD prevention in Nepal.

1.3 Historical development of Nepal's health system

Documented history of the health system in Nepal dates back to Lichchhavi era (4^{th}–7^{th} century) and in particular, King Anshu Verma (605–620 AD) (14). Evidence shows that King Verma had established Aarogyashala (possible Ayurvedic hospital) as well as setting rules and directives on safe motherhood practices during his reign. Another documented development of the health system was during the Malla era (10^{th}–18^{th} century) where Malla kings promoted the Ayurvedic medicine system. Modern health and medical systems (allopathic medicine) in Nepal were first introduced during this Malla era through Christian missionaries (14, 15). However, they were unable to get a

foothold and Ayurvedic medicine continued to be the main health system of the country until 1850. During the Rana regime (1846–1951), when the ruling Shah Kings were confined to ceremonial positions without any executive power and Rana families ruled the country on the behalf of the Kings, several key developments in the modern allopathic medicine took place, including the establishment of a network of district and central hospitals (14).

The adoption of modern approaches to disease prevention and health promotion started during the mid-1950s during the first five-year plan (16). A Ministry of Health was established along with the start of malaria eradication programmes during the first plan period. In subsequent plans, prevention programmes for smallpox, leprosy and tuberculosis were initiated through vertical programmes. Due to the influence of the Alma-Ata Declaration in 1978, during the fifth five-year plan, the Nepal health system adopted a Primary Health Care strategy and integrated parallel vertical programmes into an integrated service delivery approach. The eighth five-year plan is considered as a landmark plan period as it was based on the New Health Policy 1991 and emphasised a primary health care (PHC) approach to service delivery that focused on rural areas. Key structural changes occurred during this period through creating networks of primary health care institutions (sub-health post, health post and primary health care centres) to promote health and prevent diseases, which were guided by PHC principles of community engagement, intersectoral coordination, universal coverage, and commitment to health equity and social justice.

The current Nepalese health system is based on this structural reform in 1991 and has a centralised system of functioning. The health system can be separated into two broad

interconnected levels: policy and implementation levels (Figure 1) (17). At the policy or national level, the Ministry of Health and its central departments are the main governing structures for ensuring primary health care delivery to the people of Nepal. Regional Health Directorates play a coordination and facilitation role in linking policy level with implementation level. At the implementation level, District (Public) Health Offices [D(P)HO] and their subsidiary health institutions are responsible for the delivery of the primary health care services. At the grassroots level, Female Community Health Volunteers (FCHVs) mobilise communities for MCH promotion and other health promotion actions. Under the Ministry of Health, network of district, regional and central hospitals provide curative care services. Nepal has significant experience in implementing community-based MCH promotion programmes where strong leadership, a community-based approach and external development partners' support has significantly contributed to the reduction in maternal and child mortality (18, 19).

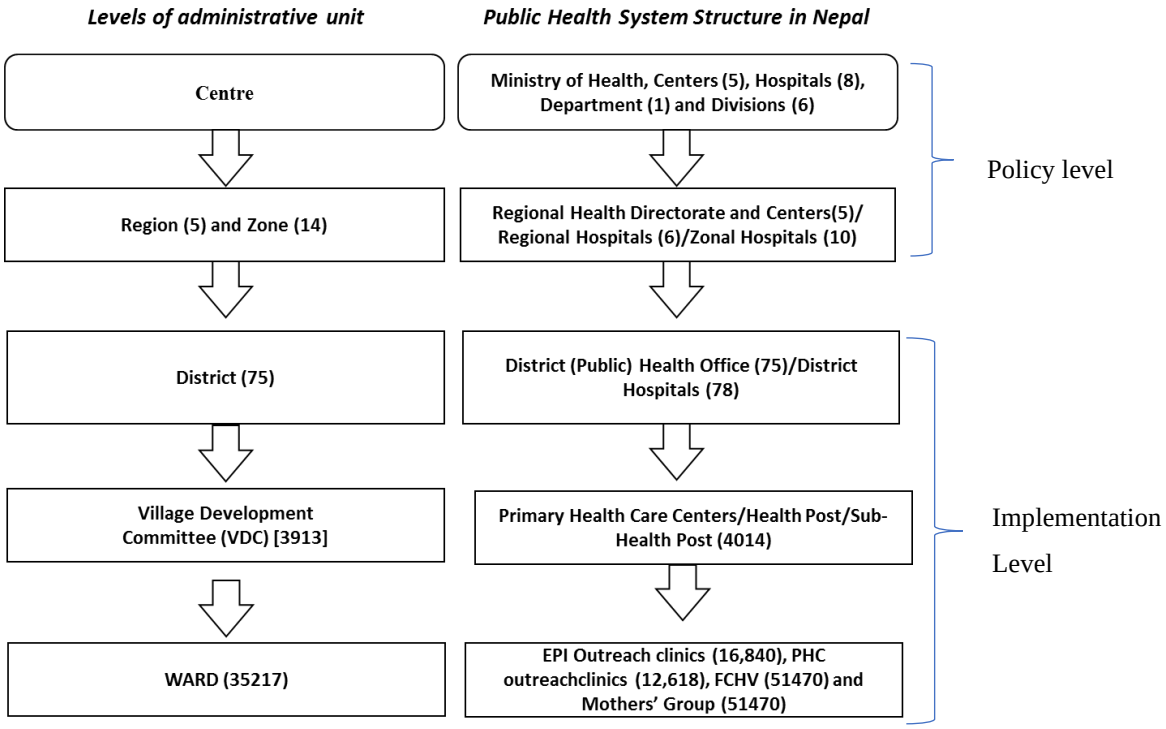


Figure 1. Primary healthcare delivery system of Nepal

Most recently, the health system of Nepal is undergoing structural and functional changes due to adoption of federalism and this has further increased opportunity to consolidate the primary health care approach to health service delivery and address health inequity (20). Nepal now has seven federal provinces and each province has corresponding Ministry of Social Development under which province health departments are institutionalised and functioning. However, the policy and programmatic oversight is still provided by the federal Ministry of Health. In other words, the fundamental system structure and service delivery model remain the same, i.e. community-based and primary health care approaches through province health departments directed by the Ministry of Health.

1.4 Framing NCDs from SDH perspective

Historically, the global health agenda has mainly focused on preventing infectious diseases and promoting maternal and child health (21). Despite NCDs contributing to more than 50 percent of disease burden globally, the prevention of NCDs has not received significant attention in terms of aid and support until recently (21, 22). There has been a shift in priority during the past few years. The World Health Organization (WHO) has been advocating for the prevention of four major NCDs (CVDs, diabetes, chronic obstructive pulmonary disease and cancer) and their risk factors through health promotion approaches (6, 23). Significant evidence-based global health movements have provided further impetus to the comprehensive approaches to NCDs prevention and health promotion (23-26). In particular, the *WHO Framework on the Social Determinants of Health* could be effectively utilised to elucidate the complexity of NCDs issue (Figure 2) (27) .

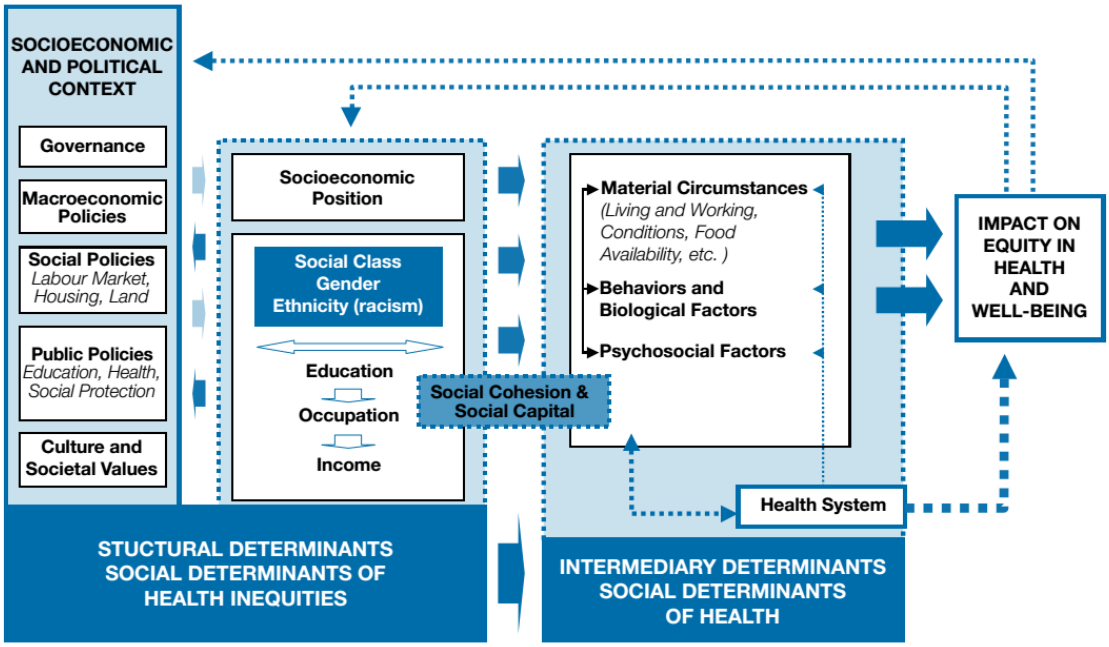


Figure 2. Social determinants of health framework proposed by the World Health Organization

The social determinants of health (SDH) framework presents a broad range of factors associated with complex public health challenges like NCDs. The framework categorises the social determinants into two interlinked components: structural determinants and intermediary determinants. Structural determinants constitute the broader socio-political context and their influence in creating social stratification. Intermediary determinants constitute behavioural, material, psychosocial and health system determinants and their linkage with structural determinants in influencing disease distribution. Social capital and social cohesion have been proposed to occupy the contested space within each of the two components, which again is critical to the health and well-being of communities. NCDs and their social determinants can be usefully understood through this SDH framework.

1.5 Rationale for the current thesis

Primary preventive approaches that include the utilisation of the primary health care system have been advocated as the best, and most sustainable way for LMIC to impact the NCDs trend (6, 28, 29). As indicated in Figure 1, Nepal has a community-based primary health care structure upon which wider prevention approaches with SDH focus could be integrated (17). There is potential to use the community-based primary health care approach with SDH focus for NCDs prevention and health promotion. Further, some recent policy initiatives against NCDs such as formulation of *Multisectoral Action Plan for Prevention and Control of NCDs 2014–2020* and reaffirmation of commitment to universal primary health coverage in the *National Health Policy 2014* and *Nepal Health Sector Strategy 2015–2020* have provided some hope for preventive actions (30-32).

Despite some progress, Nepal faces several challenges in preventing NCDs, including increasing burden of NCDs beyond the health system's current capacity, limited focus on preventing risk factors of NCDs at community level, and poor state of health system functioning and efficiency (7, 9, 10, 33-35). The current efforts of government on NCDs are mainly curative in nature with low prioritising and financing of NCDs prevention and health promotion actions (7). Most importantly, the government system lacks ways to effectively utilise the evidence of the complex systemic forces driving the epidemic as well as the policy structure to be able to respond appropriately to the epidemic (13). There is a need for information on both the contextual and systematic factors (including social determinants) contributing to the NCDs epidemic in Nepal. The rationale for using system science-based research approach to understand those systemic factors is explained in Chapter III.

1.6 Thesis research questions and objectives

The overall aim of this study is to understand the social determinants of NCDs and to identify leverage points for effective actions in prevention and control of NCDs in Nepal. Evidence gathered from both policy level and implementation level (Bhaktapur and Morang districts as two study sites) was utilised.

The specific research questions and objectives that guided this study are as follows:

1. What are the social determinants (both structural and intermediary determinants) of NCDs in Nepal?
    - Identify and describe the intermediary determinants (such as behavioural risk factors, material circumstances, psychosocial and social capital and socio-economic factors) influencing the NCDs problem in Bhaktapur and Morang districts.
    - Identify and describe the structural determinants (such as socio-political context and health and social sector policies and governance structure) influencing the intermediary determinants of NCDs in Bhaktapur and Morang districts.

2. How do these social determinants dynamically interact and contribute to the NCDs epidemic in Nepal?
    - Identify interconnection and interaction of the intermediary and structural determinants influencing the non-communicable diseases problem based on the two study sites.
    - Develop insights about the interdependencies and influences of social determinants of NCDs in the context of Nepal.

3. What health system-based strategies could be implemented for the prevention and control of NCDs in Nepal?

- Identify system leverage points for the prevention and control of NCDs in the context of Nepal.
- Based on system leverage points, recommend intervention strategies to prevent NCDs in Nepal.

1.7 Scope of the thesis

While the aim of this study is to provide an overview of social determinants of NCDs in Nepal, the information is based on two geographically and culturally different locations only. The study is geared towards identifying the social determinants of NCDs and their interaction with the health system, and what this means for health system action. Data have been collected from other relevant sectors to identify how the health sector could advocate and liaise with these sectors for addressing NCDs problem. This study provides a unique opportunity to deepen understanding of the complex public health problem of NCDs and potential solutions as well as disseminate information in a way to affect policy change and action in Nepal.

1.8 Outline of the thesis

In Chapter I, the present situation of NCDs and their risk factors and some key challenges for the health system to prevent NCDs in Nepal are discussed. The chapter elaborates on why NCDs should be viewed from social determinants of health perspective and accordingly sets out the rationale, justification, objectives and scope of this PhD study.

Chapter II provides a summary of relevant literature relating to the social determinants of NCDs and helps frame the NCDs problem in Nepal from the SDH perspective. The literature review is guided by the WHO social determinants of health framework and discusses various structural and intermediary determinants pertinent to NCDs issues in LMIC.

Chapter III presents the details of the systemic intervention methodology utilised in the research. This chapter stresses the importance of a systems thinking approach and presents a conceptual framework for the PhD study. The chapter provides justification for the adoption of the systemic intervention methodology.

Chapter IV is the results section presenting the findings of the research, which is comprised of four papers to be published in peer-reviewed journals. This collection of papers presents the social determinants of NCDs risk factors in the form of thematic analysis and causal loop diagrams, with reference to systems archetypes about challenging dynamics of NCDs issues.

Chapter V constitutes a discussion section and reflects on the methodology and overall findings from the study. It discusses how systemic intervention methodology and observation (findings) contributed to answering the research questions for this PhD project. The chapter also reflects on the leverage points for systemic actions on the social determinants of NCDs based on the study findings.

Chapter VI presents the implications, recommendations and conclusion of the study. This chapter emphasises the insights drawn from the PhD study in terms of stating

implications for policy and practice by the health system of Nepal and recommending actions on the identified leverage points through coordinated, collective action by all sectors led by the health system in addressing the social determinants of NCDs.

Chapter II: Literature review

The first chapter explored the magnitude of the problems and health system struggles in addressing the increasing problem of NCDs in Nepal. This chapter outlines the relevant literature that has helped to develop an understanding of the various social determinants contributing to the problem of NCDs in Nepal and similar LMIC before the commencement of this study. At the end of this chapter, the knowledge and research gaps are presented, which led to this study of understanding the NCDs issue in Nepal from an SDH lens.

The literature review presented here follows the structure of the SDH framework of WHO (27). The review first discusses the evidence of metabolic risk factors and NCDs in Nepal and then presents the downstream or intermediary determinants as well as the upstream or structural determinants of NCDs in Nepal.

2.1 Metabolic risk factors and NCDs

It is estimated that more than half of the disease burden in LMIC is due to NCDs (7, 8). The major NCDs in Nepal and similar LMIC are CVDs, CRDs, cancers, diabetes, injuries and mental health (neuropsychiatric conditions), with CVDs alone contributing to 20% of the total burden in Nepal (7-9). The actual burden and trend of NCDs in LMIC (due to poor vital/death registration) is often unknown (3). However, the prevalence of NCDs has been estimated from the prevalence of metabolic risk factors obtained from national level surveillance (10). Metabolic risk factors have often been utilised as a proxy for understanding the NCDs burden in LMIC and have been utilised for the surveillance of NCDs at country level (10, 12). The key metabolic risk factors include elevated blood pressure, high blood sugar, high cholesterol, and obesity, which are considered key indicators of NCDs prevalence (12, 36, 37). These metabolic risk factors can be easily assessed at field level using portable instruments (10).

The section below explores the intermediary and structural determinants and their interactions influencing the NCDs (and metabolic risks) problem to identify gaps and challenges in NCDs prevention and health promotion in the context of LMIC like Nepal.

2.2 Intermediary determinants of NCDs and metabolic risks

The intermediary determinants such as behavioural, material and psychosocial factors, district health system, and social class and community cohesion are briefly discussed below.

Behaviour, material circumstances and psychosocial factors: A major collaborative study has shown that common behavioural risk factors of NCDs include tobacco consumption, alcohol use, physical activity and dietary intake (36). These four behavioural risk factors have formed the basis of the global NCDs action plan and national level surveillance of NCDs (6, 10). Material circumstances (having materials access and adequacy for a healthy life) that are linked with socio-economic status/conditions have been found to be associated with health status and its distribution (38, 39), as has been seen in the areas of maternal and child health and tobacco use in Nepal (40-42). The psychosocial factors (combination of psychological and social factors) as a result of the social stress have also been associated with NCDs and so are the material circumstances (27). However, such aspects are not extensively explored in the context of LMIC. The argument that behavioural risk factors are solely responsible for NCDs epidemic is being increasingly rejected due to emerging evidence of social determinants of health. Health agencies and experts have gradually started to explore the causal linkage among NCDs, metabolic risks and broader social determinants for effective actions in LMIC (4, 43-47).

Local health system: The local health system in LMIC has many systemic issues for effective service delivery, including prevention of NCDs. Key systemic challenges lie in governance, management and adequate resources for effective functioning of local

health institutions (48, 49). A paper by Aitken in the 1990s critically analysed the challenges in managing local district health service in Nepal (50). These challenges are still relevant for the Nepalese context. Aitken discussed the task-oriented and incentive-based thinking of the staff in the health system who did not give attention to the quality of service delivery. Management of district health systems and skills of the health workers were identified as key determinants for effective preventative service delivery. There has been continual advocacy for involving Community Health Workers (CHWs) in the NCDs prevention programmes in LMIC as CHWs have played a critical role in reducing maternal and child deaths in those countries (51, 52). However, CHWs are already overburdened and demotivated as they are engaged in number of community based health programmes despite their volunteer status and are provided limited incentives for leading such community based programmes (53-55). Recording and reporting, a vital part of any health system, have been poor at local health facilities in LMIC like Nepal (56). The state of community participation at local level remains questionable in the health system context of Nepal (57, 58). All these factors can hugely impact the prevention of complex challenges like NCDs.

Social class and community capital/cohesion: Evidence shows that social class relating to education, occupation and income could influence the prevalence of NCDs and their risk factors in both developed and LMIC (59-64). The INTERHEART case-control study done in 52 countries showed that low education was significantly linked with risk of acute myocardial infraction in all high-, middle- and low-income countries (61). In the same study, behavioural risk factors explained half of the socio-economic gradient. However, a recent systematic review clearly showed a high burden of behavioural risk among low socio-economic group in low- and middle-income countries (64). Similarly,

social epidemiological evidence has increasingly linked social capitals and cohesion to health outcomes (65, 66). Social capital is usually the result of interrelationships and resulting features such as trust, respect and support among the members of the community that facilitates collective action. Social capital should be considered a key social determinant of the NCDs in Nepal due to its multi-culturalism. Nepal has different ethnic groups that have their own unique cultural histories and practices and these cultures have co-existed for many years in harmony within small geographical boundary. However, historical categorisation of these ethnicities into different social strata or caste by rulers of Nepal (also, known as caste system) has also resulted in a deeply rooted structural discrimination and violence against those categorised as a lower or impure caste. In Nepal, the caste system has classified ethnicities mainly as Brahmin (the scholars), Chhetri (Rulers, Fighters), Vaisya (Merchant, Farmers), Sudra (Labourers, Servants including foreigners) and Dalit (Outcaste, untouchables) (67-69). Sometimes, ethnic groups are classified more simply as higher castes (Brahmin, Chhetri, High caste Newar), middle caste (Disadvantaged Indigenous group such as Magar, Chhetri, low caste Newar) and lower caste (Muslims, Dalits). Further, ethnicities are also classified by those having a tradition of abstaining from alcohol consumption (Tangadari or holy thread bearer like Brahmin and Chhetris) and those consuming alcohol as part of cultural practices (Matwali or Janjati or Indigenous groups). Despite the abolishment of this discriminatory caste system as early as 1963 and criminalisation of caste-based discrimination in 2011, caste-based discrimination still exists widely. Thus, multi-culturalism provides both opportunities and challenges to leverage social capital for NCDs prevention in the context of Nepal.

The Ministry of Health in Nepal has classified different ethnicities into six groups which can be basically aggregated into two broad categories based on their socio-economic status, health conditions and equity and access concerns, which are advantaged and relatively disadvantaged ethnic groups (70). Brahmin, Chhetri, Newar, Thakali and Gurung are classified as advantaged ethnic groups whilst Dalits, some Janjati, Terai caste (excluding Terai Brahmins) and Muslims, are categorised as relatively disadvantaged ethnic groups.

2.3 Structural determinants of NCDs and metabolic risks

The structural determinants constitute health system policy and practice, broader socio-political context and global influences that are driving the intermediary determinants as indicated in figure 2 (Chapter I) and are discussed in further detail below.

Health system: Health system governance and structure pose unique challenges for NCDs prevention. Good governance continues to be an important aspect of health services delivery and resulting outcome (48). Features of good governance include cultivating accountability, engaging stakeholders, setting shared direction and stewarding resources. Anecdotal evidence from Kenya and Ethiopia shows that effective governance is key to the success of public health programmes and vice-versa (48). However, governance challenges have been a key feature of the LMIC (71). Governance challenges include political interference, inefficiency and corruption. According to Management Sciences for Health, governance has not been extensively studied in the case of public health (48, 49).

Many LMIC still have the traditional structure to address maternal and child health issues (17, 72). While some countries have initiated structural reforms (73-75), in Nepal, there is a lack of the necessary health system structures at policy level for NCDs prevention and control (13). In addition, funding is scarce and less prioritised for NCDs within national budgeting. In the case of Nepal, only about 5% of budget is allocated to the health sector and this has been reduced from 7% in 2011 (76, 77). A recent analysis further shows that NCDs prevention receives only 7% of the national health budget in Nepal (78). Further, most of the health budget goes to curative services and MCH services with minimal budget on health promotion and behaviour change communication programmes.

Generation and use of evidence relating to social determinants are scarce in LMIC like Nepal compared to high-income countries (HIC) (79-81). This has resulted in stronger prevention actions by HIC, including successfully integrating the SDH concept within their policies and strategies (82, 83). There is need for strengthening the evidence generation system that can support comprehensive health system action. However, there are limited data and evidence relating to social determinants health in Nepal. Specifically, the influence of social position and its gradient-like effect on health outcomes like NCDs has not been extensively studied in Nepal. However, risk factors like tobacco consumption have been found to be more prevalent among the illiterate and low socio-economic groups in Nepal (41). It could be speculated that the vulnerable population group will be more affected by NCDs problems and will have limited access to available healthcare. Similar evidence of health inequity has been observed for communicable diseases and MCH issues in Nepal (84).

Socio-political and economic context: Politics is an inseparable part of public health policies and programming (85, 86). Political ideology of the ruling party affects health policies and strategies. Political influence on public health policies and practices are often an under-studied area (87). Some of the key political science models that explain how socio-political factors influence the public policies include (i) Policy Triangle Framework, (ii) Advocacy Coalition Framework, (iii) Kingdon's multiple stream framework, and (iv) Interrupted Equilibrium Model (87, 88). While detailed discussion of the above models is out of the scope of this study, a common consensus that can be drawn is that policies are the reflection of the political ideology and social value system of a country.

Nepal is one of the poorest nations in the world; it has a democratic government and predominantly capitalistic and market-oriented policies. The governance system is plagued by political interference, corruption, lack of transparency and accountability (89-91). Livelihood issues have been major concern, with about 25% of the population below the poverty line as per the World Bank measure of national poverty headcount ratio (92). Only basic primary health care and primary education are ensured by the state (77, 93-95). Further, gender constructs within a society and their influence on NCDs outcome are a key neglected area (96). Gender becomes more pertinent in the context of Nepal, which is a patriarchal society and gender discrimination is widely prevalent (97, 98).

The Nepalese community is predominantly rural and comprises of multi-ethnic groups who have been living peaceful and pluralistic communal lifestyles (99, 100) despite socio-economic challenges. The strong social value system and community cohesion

have been evident by the success of some community-based health promotion programmes (18, 101, 102). The health system, despite its deficiencies, has been able to utilise this community's strengths for health promotion programmes, but this has also resulted in the overburden of work among such community health workers and volunteers as discussed above. There is opportunity to utilise this community-based approach to prevent NCDs, but in a strategic and systemic way.

Recent political changes have shaped the new policies and strategies towards becoming pro-poor and equity oriented (30, 95, 103-108). However, political commitment, effective governance and government stewardship to guide these policies are lacking and are continually leading to inequity in service utilisation and pushing people into poverty (40, 109-112). There are limited studies relating to the effects of politics and adopted policies on NCDs-related health outcomes in Nepal and globally as well. In other words, the interaction and influence of socio-political, economic and health system factors on NCDs issues have not been extensively studied in the context of Nepal.

Global context: Globalisation and its effect on public health are well known (113, 114). While the World Trade Organization membership has its positives and negatives, the open trade policies for member countries have added public health challenges for the LMIC with easy access to cheaper processed food and sugary drinks. Studies have shown that global processed food and sugary drink products have directly attributed to the increase in NCDs, especially in LMIC (115-117). In contrast to most HIC who have strong public health system and resources in place to respond to the health effects of processed food and sugary drink products, LMIC have weak health systems and very

limited resources (117). Even with these constraints, a few LMIC's like Mexico are doing exceptionally well in countering the health effects of processed food and sugary drink products through strong public health policy measures. While many HIC are still struggling to deal with harms associated with the influences of global food and drink companies through policy (118).

Even in HIC, disadvantaged population groups have poorer health outcomes and are most affected by the increasing processed food consumption due to the affordability of those food products (119-123). The exploitation by global industries has become more evident in the case of tobacco where all the tobacco companies come together to fight against any legislative measures in any country (124, 125). Due to the World Trade Organization membership and international cooperation agreements, policies within countries are being increasingly influenced by global economic factors that lead to the proliferation of alcohol, tobacco and processed foods (113). However, WHO has been leading the *Framework Convention for Tobacco Control* to counter the globalisation of the tobacco epidemics (126). Nepal is a signatory to it and has been taking some concrete action based on the framework.

WHO has also developed a global action plan framework for the prevention and control of NCDs (6). It is evidence based and emphasises collaborative action led by the member country. Many countries have formulated their local action plans based on the WHO's framework (127-130). Nepal is also among the few countries that have taken some steps towards its formulation but there are many challenges (13). Most LMIC, despite having a comprehensive strategy, have been unable to significantly reduce the premature morbidity and mortality compared to HIC (3).

There are opportunities to learn from both the successes and failures of HIC to tackle NCDs. Many HIC have established and implemented frameworks at policy level, which have been guiding the holistic approach to NCDs prevention and health promotion. New Zealand Health Policy of 2000 is often hailed as policy comprising of the social determinants of health concept (27, 131). New Zealand has been able to improve the health conditions of its Indigenous Māori people through actions on social determinants of health compared to other countries (132, 133). New Zealand government, in the past few decades, has been actively trying to honour the Treaty of Waitangi (a historical treaty between British Crown and Māori tribal leaders to ensure Māori autonomy and facilitate peaceful settlement of European settlers in New Zealand signed in 1840), settle the Treaty breaches with Indigenous communities through social and economic compensations and adopt Māori worldview guided social, political and economic policies and practices for Māori communities. For example, there is a separate ministry for Māori development to lead and monitor public policies relating to Māori. Māori worldview and framework guided social and health policies and programmes such as Whānau Ora (134) and E Tū Whānau (135) are being implemented through health and social development ministries. Further, socio-economic settlements of the treaty breaches with Māori communities are underway through the Waitangi Tribunal since 1975 (136). South Australia, one of the federal states of Australia, is leading the implementation of *Health in all policies* approach for action on social determinants (83, 137). But even HIC are struggling to reorient their health systems to be able to better focus on prevention of NCDs and promote public health such as in the US and Australia (138, 139). The strategy to prevent NCDs and promote public health system is very much dependent on the political commitment and availability of resources for any country.

Similarly, foreign aid is the major source of financial resources in LMIC like Nepal (77, 140). Often, donor interests are reflected in determining priorities of LMIC, which is a worldwide phenomenon (141, 142). Donors are not allocating enough funding for NCDs despite compelling evidence of increasing burden of NCDs in low-income countries (22, 143, 144). Some of the key reasons for limited funding for NCDs prevention globally include complexity of NCDs issue, timing of Millennium Development Goals (MDG), weaker grass-roots movements, weak business case for development agencies, vested commercial influences and weak evidence base (143). In particular, Nepalese health system has been largely focused in achieving MDG goals of improving maternal and child health since the start of the millennium backed by financial resources of donor agencies, ignoring the rising burden of NCDs. Globally, only two percent of the overseas development assistance for health is expended on NCDs issues (144).

2.4 Knowledge and research gaps

There is limited evidence available on the influence of structural determinants such as socio-political context, social sector policies and structure, and socio-economic status on NCDs prevention in Nepal. In particular, the issue of NCDs is perceived differently by different stakeholders, highlighting the importance of incorporating the perspectives and experience of affected individuals, community stakeholders, health workers, managers and policy makers to understand and address the social determinants of NCDs. This thesis would complement current local evidence relating to NCDs that offer limited evidence and insights on social determinants of NCDs. Some of the emerging questions relating to social determinants include: How are NCDs being experienced from a community perspective? How is NCDs and the behavioural risks affecting

different communities and different population group (rural and urban; male and female; disadvantaged and advantaged group)? What does this mean for the health system and for health policy? Community perspective is essential for understanding the practices and factors leading to NCDs risks and assessment of what is working and what is not in relation to prevention efforts of the health system. Why is the health system (and donors) more interested in funding medical and technological-based interventions, as has been the case in LMIC for many decades? Could the limited evidence on social determinants and lack of systemic effort be the reason for donors' lack of interest? Can and should Nepal develop its own initiatives based on its traditional knowledge system? Despite recent formulation of a multi-sectoral action plan for NCDs Prevention and Control in Nepal, the plan seems to be rhetoric rather than an active action plan for intervention based on social determinants of health. Little is known about the different intersectoral policy and programme level opportunities and challenges that exist for NCDs prevention and health promotion in Nepal. Health system needs to understand the complex interaction and influence of the broader determinants such as socio-economic circumstances (determined by income, ethnicity and occupation) and inter-sectoral policies on the NCDs epidemic in Nepal.

There is an urgent need for curbing the NCDs epidemic through understanding the social determinants of health and identifying appropriate strategies and policy levers within the Nepalese context. The evidence from this thesis will provide some key strategic directions to the health system of Nepal in preventing NCDs.

Chapter III: Methodology and method

This chapter discusses the use of systems thinking/ systemic intervention approach and related study design adopted for this PhD study. The adapted WHO framework utilised to facilitate systems thinking approach within this study is presented. The systemic intervention methodology, which emphasises critical systems approach and use of multiple methods to understand a complex problem, is discussed. Finally, the overall study design and details of the case studies, including data collection and analysis and ethical considerations, are provided.

3.1 Systems thinking approach for SDH research

Public health often deals with complex issues that are multi-factorial and multi-level such as malnutrition, maternal mortality and non-communicable diseases. Many comprehensive frameworks such as socio-ecological model and social determinants of health frameworks have emerged recently to depict the complexity of public health issues. However, these frameworks need methodological guidance for contextualisation and utilisation in practice. The lack of progress in addressing such complex public health challenges highlights that these existing approaches and frameworks are insufficient to deal with the complex challenges. Some are now arguing that a lack of holistic or systems view may be responsible for the repeated failures in public health programmes and impasse in dealing with complex problems (145). In this regard, systems science is proving to be a promising approach to understanding and dealing with complex public health problems where interactions are key (146, 147). A systems view sees complex problems from the perspective of the whole system in order to understand the key attributes being generated from the interaction of internal parts of the system and the external environment. Some key attributes of complex system include being self-organising, dynamic, non-linear, governed by feedback, history-dependent and resistant to change (148).

There is a suggestion that comprehensive frameworks like the SDH framework may be improved upon by allowing greater contextualisation and effective utilisation if a complex systems approach is applied (149). Advocates of systems thinking argue for its potential in public health as it provides basis for deeper understanding, adaptation and continuous learning and reflection (150-152). A systems approach can be applied in each and every step of public health practice as follows: understanding public health

problems, planning and designing interventions, and evaluating the effects in a real-world setting.

Systems methods and tools are better suited for illuminating the dynamic structure and emergent behaviour of complex health problems like NCDs. In particular, systems dynamics methods have been widely utilised for understanding and modelling NCDs-related issues in HIC that are generating compelling evidence for policy actions (147, 153-157). System dynamics has been used to model the impact of health policies in the United States (157) in order to understand obesity issues from the systems perspective in the United Kingdom (155). There are very few instances of application of system science methods in LMIC (158, 159). The systems approach could aid in understanding the complex issue of NCDs prevention and health promotion to enable the design of system-based health promotion policies as well as community-based intervention strategies.

3.2 The adapted WHO framework to guide the PhD study

This study focused on understanding the social determinants of health impacting NCDs and explored intervention strategies for their prevention in Nepal using the system thinking approach. The SDH framework of the WHO was adapted (figure 3) to suit the purpose of this study due to its simplicity and relevance. The adapted SDH framework both shaped the key research questions for different levels (national and implementation) of inquiry and guided the development of research tools to generate holistic information relating to the social determinants of NCDs and facilitate systemic interpretation of the complex causal mechanism of NCDs in the context of Nepal.

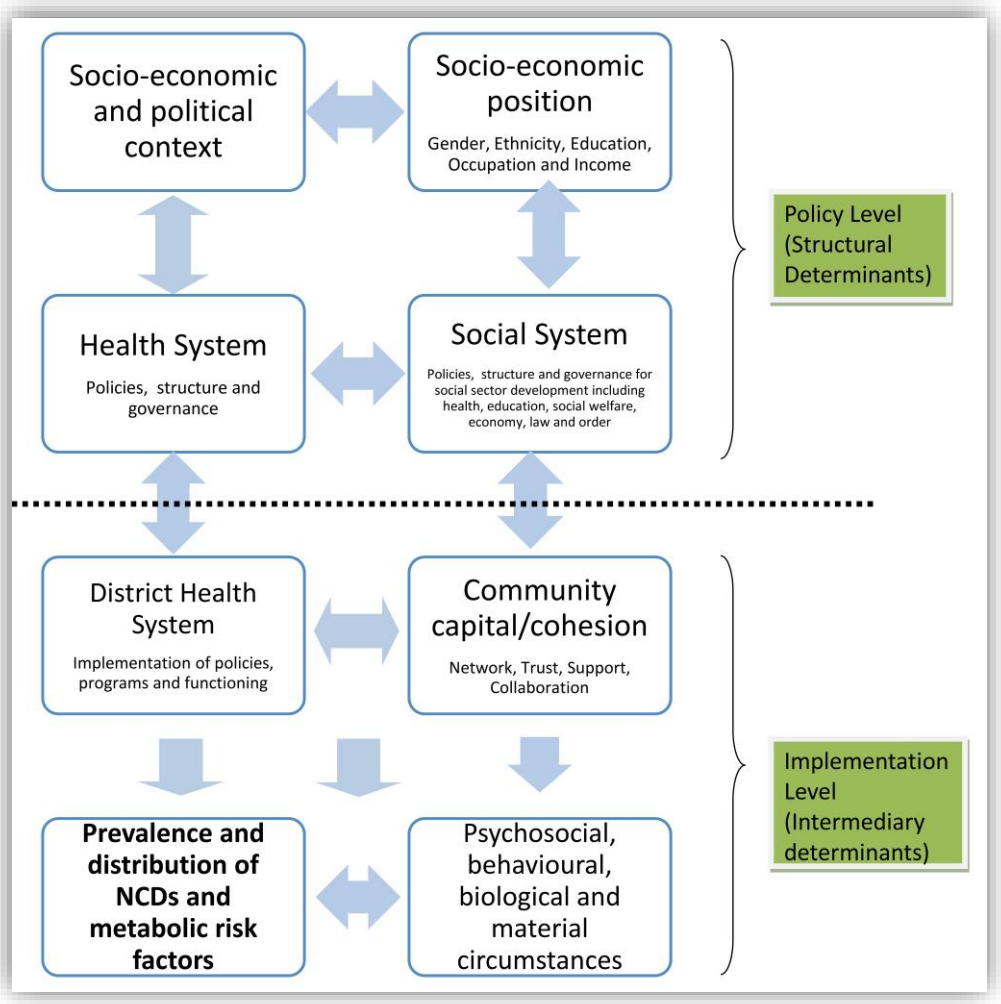


Figure 3. Study Framework for PhD project adapted from the SDH framework of the WHO

In the adapted framework, the two broader categories of the social determinants (i.e. structural and intermediary determinants) have been assumed to be closely linked with two interdependent levels: national (structural) and implementation (intermediary) respectively. At policy level, this study aimed to understand the structural determinants and, at implementation level, the intermediary determinants. However, these levels were not exclusive to the corresponding social determinants and many overlaps and interconnections among social determinants were found during the learning process. While the adapted framework was comprehensive and helpful to guide understanding of

complex issue in NCDs, there were limited research methodologies and methods within public health science that can provide methodological guidance for this study. The next section discusses how this PhD research was informed by a systems science methodology, namely systemic intervention.

3.3 Systemic intervention methodology

A research methodology is often defined as a systematic and logical analysis of the methods chosen and applied in a study (160). The study team (PhD candidate, a primary supervisor and four co-supervisors) wanted a system science methodology that would enable the achievement of the study objectives (in Chapter I). The study team explored different systems methodologies applicable for this study. The study team were certain that this study required multiple methods along with some of form of participation of stakeholders as a part of this research. In this study, choosing systemic intervention (SI) as a guiding methodology was bit straightforward as one of the supervisors was familiar with works of Gerald Midgley, a pioneer of SI approach (161, 162). The SI approach provided both philosophical and methodological foundation for the social practice intervention and involved critical reflection of boundaries through stakeholder engagement. This also addressed a key criticism of public health research, which is often tagged as being direct and not considering the philosophical and methodological aspect of the research process.

The SI approach enabled adoption of critical systems thinking and multiple methods in this study. The methodological approach (figure 4) sat well with the objectives of the research (Chapter I) to understand the social determinants of NCDs in the context of Nepal.

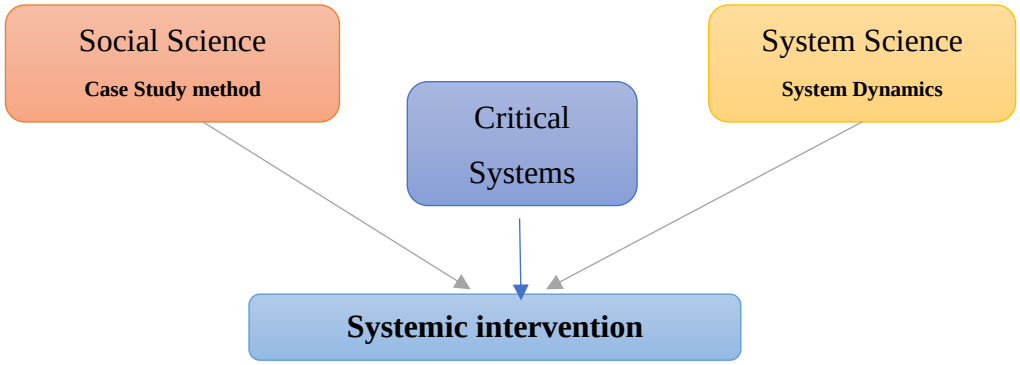


Figure 4. Methodological framework of the study

Core constructs of the research methodology i.e. systemic intervention

Methodological pluralism and critical systems thinking were the two core constructs of systemic intervention methodology of this study (161, 162). Methodological pluralism emphasized on creative mixing of methods from different disciplines to adequately understand and tackle a complex problem. A combination of two key methods from different paradigms, case study methods (163) and system dynamics (152), was adopted for this study. The case study method helped to frame qualitative data in the local context settings (163). It helped to identify variables that may be associated with the variables of outcomes and how feedback may operate in a local context. Further, multiple cases provide the basis for case comparison and analysis to understand the generative mechanism for different contexts. Similarly, the system dynamics method was used to develop causal loop diagrams (CLDs). CLDs, based on the system dynamics approach, depicted dynamic and non-liner causality in the form of mapping (152).

Both methods informed and complemented each other and are based on systemic intervention methodology. The case study method helped in framing the quantitative and qualitative data to understand the generative mechanism of a complex issue like NCDs, and causal loop diagram (based on the system dynamics method) helped in depicting the causal linkages identified through case study analysis and simultaneously improved the case study analysis by providing additional insights on causal mechanism. In this study, case study methods were utilised first to analyse the data and understand the causal linkage. This analysis of case study data was used to inform and enrich the causal loop diagram, which was developed using the system dynamics technique. CLD is often considered as a simple but effective tool to communicate with stakeholders in particular (152, 155). CLD showed how various factors were dynamically interlinked to form interconnected loops and contributing to complex problems like NCDs (158, 162).

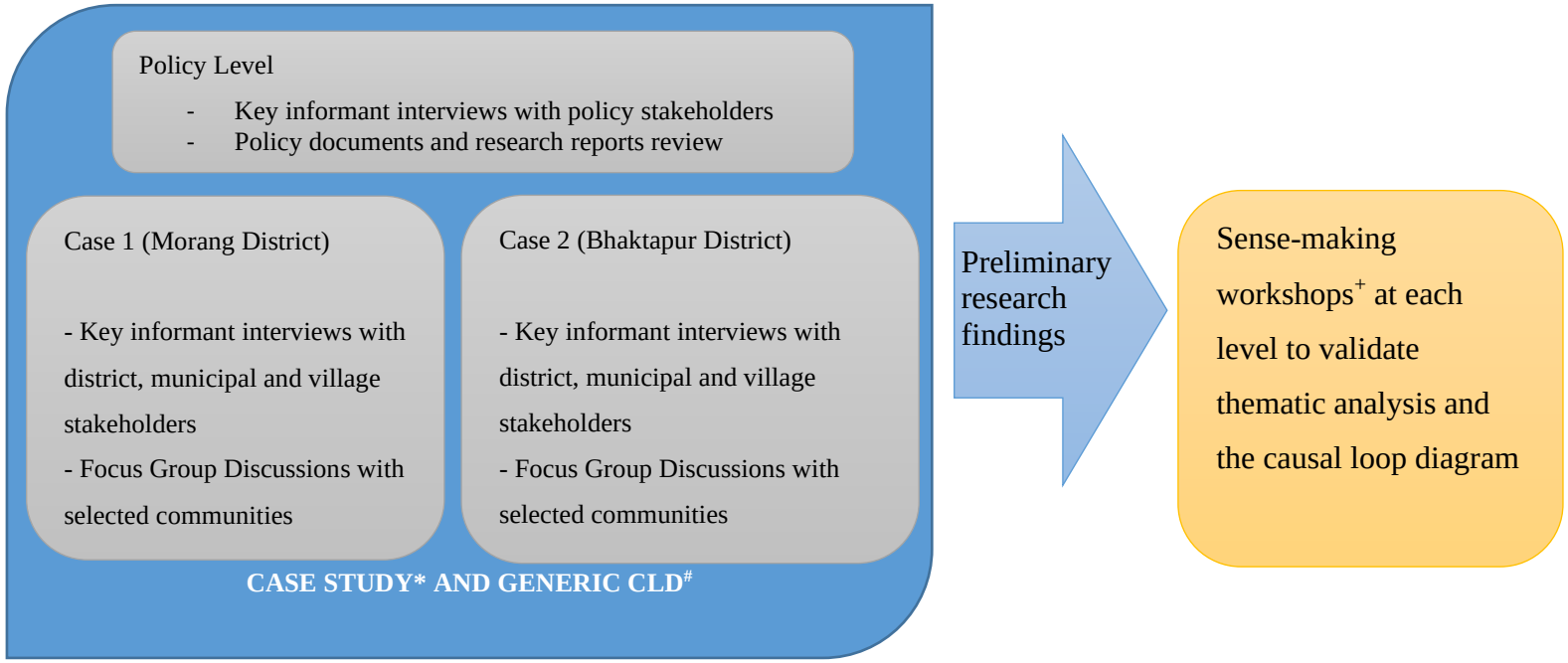
A sense-making workshop was conducted to further improve and validate the qualitative analysis, including causal loop diagrams, which is a critical systems approach inherent within systemic intervention (161). Through a sense-making workshop, the identified causal mechanism and possible leverage points were critically discussed with stakeholders, which ensured relevance and ownership of findings by those who were being impacted by NCDs as well as engaged in NCDs. Critical systems thinking has human emancipatory interest and aims to address the asymmetric power relations in understanding the complex issues of NCDs, which have disproportionate effects on the disadvantaged and marginalised groups (161, 164). Critical systems thinking is often conceived as an approach that integrates critical awareness, emancipation and pluralism lens in addition to systems thinking to tackle a complex problem (161, 164). Critical awareness involves understanding values and boundaries

relating to an issue by questioning taken for granted assumptions and conditions giving rise to such assumptions. Emancipation involves addressing power dynamics i.e. those with limited power are empowered, engaged or represented to tackle the problem. In particular, critical systems thinking harnesses the utility of critical social theory that helps examine the power dynamics and prevents marginalisation of perspectives towards understanding and addressing complex problems. A critical systems thinking guided process provide a shared and equitable space for developing a shared understanding of complex problem among key stakeholders in an inclusive way. In this PhD study, involvement of disadvantaged stakeholders and ensuring their meaningful participation has helped to critically understand the problem for the local context. While participatory approaches have been increasingly utilised in public health research and practice (165), issues like power dynamics among stakeholders or marginalisation of the perspective of disadvantaged groups may be ignored or missed during such participatory public health research if not explicitly focused. The critical systems perspective strengthens the participatory approach and guides the analysis and interpretation of the findings from a critical systems lens within the current research.

3.4 Method

Aim of the study: This overall study aimed to understand the social determinants of NCDs and identify leverage points for actions to improve prevention of NCDs in Nepal.

Study design: This research combined case study method and causal loop modelling method based on systemic intervention methodology (system science research design) as outlined in figure 5.



** Case study involved thematic analysis of qualitative information (key informant interviews and focus group discussions) from two case study districts to identify the social determinants variables and iterate on the causal mechanism of NCDs problem. Case study also involved combined analysis of the cases to illuminate the causal mechanism among social determinants*

 # Causal Loop Diagramming involved generating generic causal loop diagram based on the case analysis in the context of Nepal

+ Sense-making workshop was conducted at each of the case districts and at national level to iterate and validate the respective causal loop diagram and identify the potential levers

Figure 5. Outline of systemic intervention research design

Case study areas: The study was based in Nepal. Policy level (or national level) information was collected by interviewing key stakeholders involved at policy level in Kathmandu, the capital city where Ministry of Health, Department of Health Services and other key central agencies are located. Implementation level (district and community level) information was collected from two purposively selected case districts representing two distinct geographical regions of Nepal: Morang district from Terai (plain) region and Bhaktapur district from Hill region. Nepal within its small geographical boundaries has three types of topography: Mountains (snow-capped mountains), Hills (hilly topography) and Terai (plain areas). These different topographies also provide home to diverse ethnic and cultural groups in Nepal.

The selected districts (Morang from Terai and Bhaktapur from Hill) also have diverse ethnic groups and influenced by deeply rooted caste system (67-69). In Morang district, there are many ethnic groups such as ethnic groups of hilly origin who immigrated to plains (also known as Pahadiya by local population and often the privileged groups), local Madhesi (people of the plains) population including high caste Madhesi (e.g. Kayastha, Yadav) and low caste Madhesi (Sudi, Teli, Dalits), Indigenous group such as Tharu and Muslim minority. In the Bhaktapur district, the predominant population are Newar, who are also Indigenous communities and have similar hierarchical caste-system discussed earlier in section 2.2 (166). Within Newars, there are groups or clans who are considered high caste Newar (e.g. Bajracharya, Vaidya, Shrestha) and they are the ruling and trading groups. Some Newar clans collectively called as Jyapu are engaged in farming and are considered middle caste Newar. However, some Newar clans (e.g. Pode) are considered the low caste Newars and most of them are underprivileged labourer workers. In particular, Bhaktapur with its proximity to capital

city, has a huge immigrant population from other districts of Nepal, some of whom are of low socio-economic background and live and work in poor conditions.

Morang district is also known as the industrial district and many people are engaged in the industrial activities (167). However, agriculture is the major source of livelihood for the population of both districts. In Bhaktapur district, most of the population are engaged in business or service sector due to the close proximity of the district with the capital city (Kathmandu) with small population engaged in traditional farming (especially Jyapu Newar). Biratnagar Municipality (urban cluster), Bahuni (rural cluster) and Tankisinwari (rural cluster) of Morang district and Thimi Municipality (urban cluster), Sipadol (rural cluster) and Dadhikot (rural cluster) of Bhaktapur district were purposively selected from the case districts for community level information in consultation with respective District Public Health Offices (figure 6).

	Study Area	Interview	FGD
Policy Level	Kathmandu	24	-
Implementation Level Case I	Bhaktapur (Thimi, Sipadol, Dadhikot)	19	6
Implementation Level Case II	Morang (Biratnagar, Tankisinwari, Bahuni)	20	6

Figure 6. Map of Nepal and study area highlighted

Case study techniques and tools: Within each study site (cases 1 and 2), the data collection techniques included key informant interview and focus group discussion.

Key informant interview (KII): KIIs were conducted with 39 key informants from the two case study areas (20 from Bhaktapur and 19 from Morang). The intended participants for interview at district level included district level health and social services managers/stakeholders, municipality level health workers/stakeholders and village level health workers/stakeholders.

Focus Group Discussion (FGD): In total, 12 FGDs (5–10 participants) were conducted with community people in general, focusing on the behavioural and

metabolic risk factors of NCDs in the two study sites. While there were no specific criteria for the selection of communities within the cluster for FGDs, at least one FGD was conducted in a disadvantaged community (in terms of ethnicity and socio-economic circumstances) in each of the study sites (six focus group discussions per case/study sites) for better understanding of social determinants.

The policy level case data to feed the implementation level data from the two case districts were obtained from the key informant interviews with key policy stakeholders (n=24). The intended participants from policy level included members of *NCDs Multi-sectoral Action Plan Steering Committee*, academicians, and representatives of national level INGO/NGO who were engaged (or have potential to engage) in NCDs prevention and health promotion in the context of Nepal.

Samples for this study were purposively estimated. Purposeful sampling is often used in qualitative study for identifying and interviewing potential information-rich subjects on a complex issue like NCDs (168). Our aim was thus to capture the different perspectives and contexts on the NCDs prevention issue guided by the study framework and ultimately identify potential policy leverage points to accelerate NCDs prevention actions through multi-sectoral efforts. Here, we adopted the maximum variation sampling strategy to investigate a complex issue that emerges from across the sectors (168). We considered the health sector as the leading sector to coordinate the NCDs prevention efforts, so a greater participation from the health sector would be ensured. The details of participants, key characteristics of participants and techniques and tools used for the study have been summarised in table 3.

Table 3. *Participants, key characteristics, sample size and data collection techniques and tools*

Participants (Sample size)	Key characteristics	Techniques	Tool*
Policy Level			
Policy makers and experts (health and social sectors) [n=24; government (n=19), non-government (n=5), health sector (n=18) and non-health (n=6)]	Included participants from Ministry of Health, Home Ministry, Ministry of Education, Ministry of Agriculture, Ministry of Information and Communication, Non-government Sector and political organisation	Key informant interview	Interview Guideline
Implementation Level			
District level health and social services managers/stakeholders [(n=14); government (n=12), non-government (n=2), health sector (n=6) and non-health (n=8)]	Included participants from District Health Office, District Development Office, District Agriculture Office, District Education Office, District Administration Office and Non-government Sector	Key informant interview	Interview Guideline
Village level Health Workers and Stakeholders [(n=17); government (n=15), non-government (n=2), health sector (n=11) and non-health (n=6)]	Included participants from local health institutions, government offices, schools and local leaders	Key informant interview	Interview Guideline
Municipality level Health Workers and stakeholders [(n=8); government (n=5), non-government (n=3), health sector (n=7) and non-health (n=1)]	Included participants from local health institutions, government offices, schools and local leaders	Key informant interview	Interview Guideline
Advantaged community members [n(FGD)=6]	Included participants who were socio-economically advantaged	Focus Group Discussion	FGD Guideline
Disadvantaged community members [n(FGD)=6]	Included religious minorities and Indigenous ethnic participants who were socio-economically disadvantaged	Focus Group Discussion	FGD Guideline

** Study tools are in appendix II (Interview and FGD Guidelines) and participants profile in appendix III*

The data collection instruments were developed based on the study framework (figure 3). An adaptive and flexible approach to instrument design and improvement was agreed by the research team due to complex nature of the research questions. A generic semi-structured open-ended interview schedule was prepared for the key informant interviews which was adapted and improved as the interviews progressed and based on the background of the participants. In the key informant interview guideline, the interview questions started with request to share the background and experience of the participants in relation to NCDs prevention and control. Depending on the initial interaction, the interview progressed from inquiring about the current situation of NCDs in Nepal to questions about structural, intermediary or behavioural determinants of NCDs and the interactions among various social determinants as perceived by the participants. The time of interview ranged from 30 minutes to one hour.

The FGD guideline was also based on the study framework (figure 3). In case of focus group, it made more sense to facilitate the discussion starting from behavioural determinants and gradually progressing to discussing about lived experience and the interaction of behavioural determinants and lived experience with structural determinants. The time of an FGD ranged from 45 minutes to one hour.

Thematic analysis for qualitative data: The interview and focus group discussion data were analysed using the framework approach (169). The framework approach provided step-by-step guide from transcription to thematic analysis as described in Table 4. Transcription and translation from Nepali to English were conducted by two public health graduates based in Nepal guided by the researcher. The English transcripts were then coded based on the study framework and both deductive and inductive approaches

were utilised for identifying the major themes and underlying causal mechanisms. The themes from both cases and policy level were compared, contrasted, categorised and combined to understand and elucidate common themes and causal mechanism driving the NCDs problem in the context of Nepal. *Dedoose (Socio-cultural Research Consultants)* (170), a web-based data management platform, and *MS Excel 2016 (Microsoft)* (171) were used to manage the qualitative data and facilitate the analysis.

Table 4. *Description of the framework approach steps followed during the research*

Steps	Description
Transcription	The researcher and two assistants transcribed and translated the first three interviews together for consistency. The two assistants then transcribed and translated the rest independently.
Familiarisation with the interview/data source	As all the interviews and FGDs were conducted by the researcher, the researcher was familiar with the transcripts and its contents. The researcher reviewed the transcripts for checking consistency in transcription and quality of English translation.
Coding and recoding	Descriptive coding was done in *Dedoose* guided by the adapted SDH framework. The researcher coded the first few interviews and compared the codes for consistency in coding; this ensured codes were meaningful, clear and concise.
Developing a working analytical framework	The adapted SDH framework was the guiding analytical framework.
Applying the analytical framework, including charting the codes in the framework matrix and thematic analysis	Indexed and organised all the codes based on the adapted framework in *MS Excel*; identified the major themes against the variables within the framework and interpreted on the causal mechanism.
Interpreting and iterating to develop CLDs	We developed the causal loop diagram to map the major causal mechanism identified through thematic analysis.

Several themes emerged from the data analysis and there were some challenges relating to grouping and interpreting them. After some iteration, the themes were subsequently grouped and analysed as four interrelated thematic areas and subsequently developed into four related papers as shown in figure 7. The first paper related to the experience of NCDs by individuals and communities in the case districts. Due to the similarity in nature of the tobacco and alcohol issues, the themes relating to tobacco and alcohol use were grouped and analysed together in paper 2. Similarly, the thematic analysis of the determinants of diet and physical activity risks were also linked together in paper 3. Figure 7 also demonstrates how the four results papers were linked and complementarily highlighting the critical role of the behavioural risks in the interaction of the social determinants of NCDs. The impetus to this interaction was health and social system inefficiency, which was fuelled by political instability and limited commitment for systemic action on the social determinants of health (paper 4).

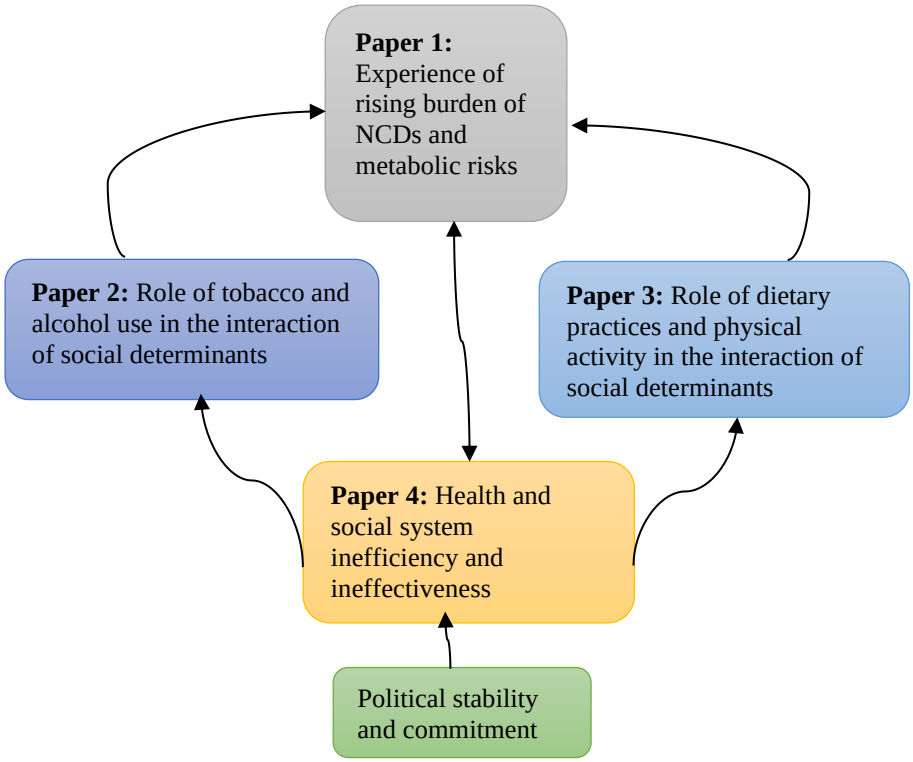


Figure 7. Linkages of the four results papers of this study

Causal Loop Diagram Modelling: Eventually the causal linkages and mechanisms, developed from the thematic analysis, were depicted in the form of Causal Loop Diagram (CLD), one of the key tools of system dynamics to illustrate the dynamic interaction of causal variables. The CLD consisted of causal variables interconnected with arrows denoting causal influence (mechanism) among variables. Though there were many ways to draw a causal loop diagram, the convention/analytical strategy to develop CLDs in this research was adapted mainly from *Business Dynamics* (appendix IV) (152). A CLD comprise of two kinds of loops: balancing and reinforcing. The balancing loops are goal-seeking loops, which are indicated by "B" within CLD, and indicate the stabilising feature of the loop. Generally, loops consisting of health intervention variables (health education campaign, screening, treatment, etc.) that try to

reduce the magnitude of health problems are examples of balancing loops. Reinforcing loops (indicated by "R" within CLD) involve actions that produce results that trigger similar actions, resulting in growth or decline, for example the vicious cycle of poverty and poor health. Further, system archetypes, which are simple versions of CLDs for understanding common problems or dilemmas within an organisation or a complex system, were also constructed to generate insights for action among stakeholders. The CLDs and system archetypes were built using *Vensim (Ventana Systems Inc.)* (172).

For the purpose of the leverage point analysis, a final comprehensive model was developed (in Chapter VI) and the model was then put through the lens of the Meadows' framework for identifying the leverage points for recommending the actions for NCDs prevention in the context of Nepal (173). The Meadows' framework provides a guide to identifying those leverage points, which have the greatest impact within a complex system (173). Leverage points are places in a system where a small shift on one variable could produce significant changes in the system (174). Leverage points can exist at multiple levels, both micro (community) and macro (policy). Meadows' framework suggests 12 points for intervention (figure 8) in the system in the order of impact (173, 175). The framework emphasises identifying and targeting the deeper leverage points for greater effectiveness. While the shallow leverage points are easily visible, the deeper leverage points are less visible and are not easily revealed without a systems thinking approach (173, 175). The causal loop diagram was utilised to identify the potential leverage points (152, 174).

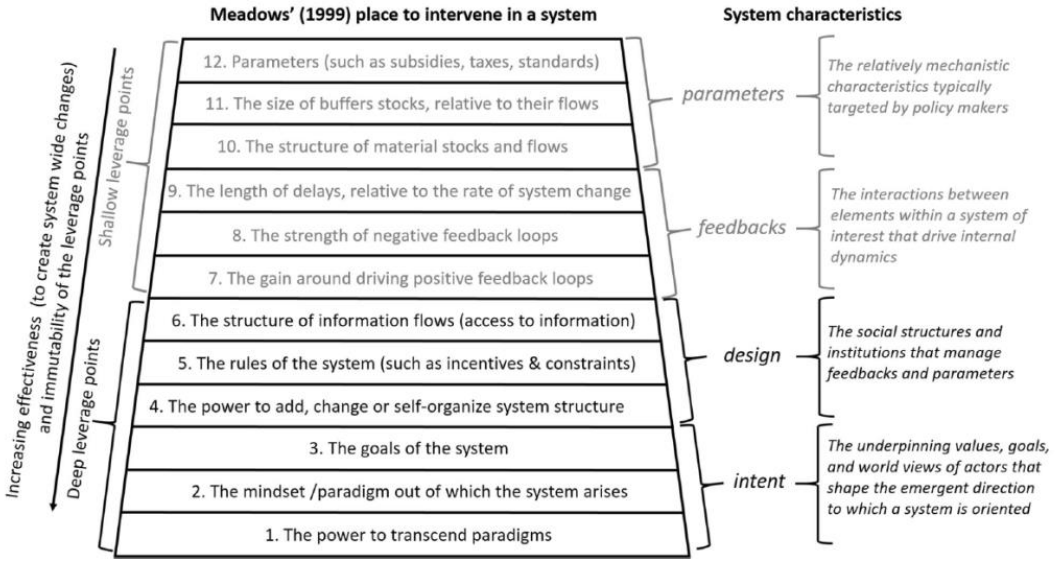


Figure 8. Meadows' twelve leverage points and four system characteristics (175)

Sense-making Workshops: In line with systemic intervention methodology, this research involved the local stakeholders in iterating and validating the research findings and causal loop diagram, which is a commonly utilised technique for participatory iteration and validation (158, 159, 176). Three sense-making workshops were conducted at each study site in early 2018 at the study sites and at national level. The causal models developed were presented along with case-based similarities and differences based on the qualitative data. A complete list of participants from policy and implementation levels who participated in the sense-making workshops has been listed in appendix V.

Ethical issues and consideration:

Formal ethical approval was taken from the Massey University Human Ethics Committee (SOA 16/37) and Nepal Health Research Council Ethics Committee (Reg. no. 163/2016) respectively (appendix VI). The study considered all four core bio-

medical ethics (respect for autonomy, beneficence, non-maleficence and justice) principles throughout the study (177) and addressed key ethical concerns as follows:

Cultural and social context of Nepal

I am a Nepali citizen and have been working as researcher in disadvantaged communities in Nepal for more than five years. I have always ensured that community-based research studies were conducted in a culturally sensitive way, including this study. The purpose of the study and its voluntary participation nature were clearly explained to all participants and, in particular, the disadvantaged and less literate groups using simple information sheet (appendix VII). Written consents were obtained from all the participants of the study in a culturally appropriate way (appendix VIII). A verbal informal consent from the family head was obtained in some cases due to the patriarchal social system.

Respect for autonomy

During the data collection phase, the purpose of the study was explained to the participants using simple-to-understand information sheets. A prior informed and written consent was obtained from all participants of key informant interviews, focus group discussions and workshop participants regarding voluntary participation, and recording of the interview/proceedings and management of information was provided.

No direct benefits to the study participants

The participants were informed that the participation was voluntary and there were no direct benefits (in cash or kind) by participating in the study. There were arrangements

of snacks for the participants of FGDs and workshops as they were requested to come to an appropriate meeting venue for discussion.

Confidentiality of the shared information

During the community level data collection, the study did not record any personal identifier such as name, house number or contact number. Consent was taken from participants regarding mentioning their statements as quotes in the research report and subsequent publications in an anonymous manner. The consent form and qualitative data (including recordings) were stored in two separate lockable cabinets. While the researcher had access to both storage cabinets, transcribers were only able to access them after signing a confidentiality agreement. The consent forms and audio-recording will be securely stored for at least ten years after the completion of this study and securely destroyed after that. Transcripts without personal identifiers may be made available to the public through an open access data repository for data transparency and publication purpose.

Chapter IV: Results

This chapter presents findings of the study in terms of four interrelated papers to be published in peer-reviewed journals. The first paper described the experience of NCDs by individuals and communities in the case districts. The second and third papers illustrated the critical role of key behavioural risk factors of NCDs in the dynamic interaction of the social determinants of NCDs. The fourth paper described the health system challenges in tackling the social determinates of NCDs in Nepal.

Paper 1: Individual and community experience of rising burden of non-communicable diseases in two case districts of Nepal: a qualitative exploration

Paper 1 describes the current experience of individuals and communities of NCDs and their metabolic risks in Nepal from SDH lens. The paper discusses three key themes relating to the experience in urban and rural areas, experience among male and female and experience of vulnerable individuals and communities. The paper links up with the other three results papers in explaining the experience of individuals and communities relating to NCDs and providing some insights on the causal linkage of behavioural risk factors and other social determinants with NCDs.

This paper has been submitted to Global Health Promotion journal.

Abstract

Introduction: Non-communicable diseases (NCDs) are a rapidly emerging global health challenge with multi-level determinants popularly known as social determinants. The objective of this paper is to describe the individual and community experiences of NCDs in the two case districts of Nepal from social determinants of health perspective.

Method: The overall study design was qualitative (case study) and guided by systems science methodology. Sixty-three interviews were conducted with key informants from different sectors pertinent to NCDs prevention at two case districts and policy level in Nepal. Twelve focus group discussions were conducted in the selected communities within those case districts. Data collection and analysis were informed by the adapted *Social Determinants of Health Framework*. The research team utilised the framework approach to carry out the thematic analysis. The study also involved three sense-making workshops with policy level and local stakeholders.

Results: Three key themes emerged during the analysis. The first theme highlighted that individuals and communities were experiencing the rising burden of NCDs and metabolic risks in both urban and rural areas. The other two themes elaborated on the participant's experiences based on their socio-economic background and gender. Disadvantaged populations were more vulnerable to the risk of NCDs. Further, being female put one into an even more disadvantaged position in experiencing NCDs risks and accessing health services.

Conclusion: The findings indicated that key social determinants such as age, geographical location, socio-economic status and gender were driving the NCDs epidemic. There is an urgent need to take action on social determinants of health through multi-sectoral action, thus also translating the spirit of the recommendations made a decade ago by the *Commission on Social Determinants of Health* in addressing a complex challenge like NCDs in Nepal.

Background

Nepal has observed a rapid growth in the burden of NCDs in the last two decades, with more than half of the disease burden due to NCDs (7, 8, 178). The majority of NCDs in Nepal belong to the four groups of NCDs (cardiovascular diseases, diabetes, chronic respiratory diseases and cancer) with cardiovascular diseases alone contributing to 22% of the total burden (7-9). National surveys indicate that metabolic (elevated blood pressure, total cholesterol and glucose levels) and behavioural risks (tobacco use, alcohol consumption, limited physical activity and poor dietary habits) factors of NCDs are driving the epidemic of NCDs in Nepal (11, 179). However, global evidence suggests that NCDs are a complex problem and driven by multi-level determinants, popularly known as social determinants (4-6, 27). It is thus clear that understanding and tackling NCDs must move beyond behavioural factors and take multi-level factors into account, including socio-economic and commercial determinants of health (3, 4). However, LMIC like Nepal have limited evidence regarding social determinants of health in addition to pre-existing health system challenges in preventing complex problems like NCDs (13). Furthermore, prevention efforts relating to NCDs are often of low priority and confined to limited behavioural campaigns in Nepal. There is a need for local evidence on the social determinants of NCDs and, in particular, the individual and community experiences of NCDs and their social determinants from Nepal. The objective of this paper is to describe the individual and community experiences of NCDs, and their social determinants based on the qualitative data from two districts (Morang and Bhaktapur) within Nepal.

Method

The paper is based on the PhD study of the first author and reports qualitative findings of the experience of the study participants relating to NCDs and their social determinants from the two case districts of Nepal. The overall study design was qualitative and informed by systems science methodology (161, 162).

Study area

The selected key informants were interviewed between July and October 2016 from two purposively selected case districts (Bhaktapur and Morang districts) and at policy level (Kathmandu, the capital city) in Nepal. Further, one municipality (urban geo-political administrative units) and two Village Development Committees (rural geo-political administrative units that are commonly abbreviated as VDC) from each districts totalling six clusters (Madhyapur Thimi Municipality, Dadhikot VDC and Sipadol VDC from Bhaktapur, and Biratnagar Municipality, Tankisinwari VDC and Bahuni VDC from Morang) were purposively selected for community level data collection (key informant interviews and focus group discussions).

Study instruments

The *WHO Framework for Action on Social Determinants of Health* was adapted by the research team to suit the purpose of this study (figure 3). The study tools were informed by the adapted social determinants of health framework. The key informant interview schedules and focus group discussion (FGD) guideline contained semi-structured open-ended questions, which were discussed extensively by the researchers and local experts from Nepal. The interview schedules and FGD guideline were first developed in English and translated into Nepali.

Study procedure

The sampling strategy to select key informants entailed purposively identifying stakeholders knowledgeable and experienced in NCDs prevention and control at policy and district levels from across the sectors (168). The key informants who were recruited varied in terms of workplace, years of experience, sectors (health as well as non-health) and expertise (implementation as well as policy level). The potential policy level key informants (n=24) were identified by referring to the list of the multi-sectoral committee members proposed by the *Multi-sectoral Action Plan for the Prevention and Control of NCDs 2015–2020* in Nepal and accordingly, finalised in consultation with supervisors and local experts in Nepal. The district and VDC/municipality level key informants (n=39) were identified through consultation with District Public Health Offices, who also helped us identify two communities within each VDC/Municipality for the focus group discussion.

Policy level key informants included participants from Ministry of Health, Department of Health Services, other sectoral ministries, national level non-government organisations and international non-government organisations. District and community level key informants included participants from District Health Office, Local Development Office, local non-government organisations, primary health centres, health posts, local schools and VDC/municipality offices. The purpose of the key informant interview was to illuminate the experience and perspectives of key stakeholders in relation to the current situation of NCDs in Nepal. The time of interviews ranged from 30 to 60 minutes and they were conducted in Nepali.

Twelve FGDs were conducted at the community level in the six selected VDCs/municipalities. Each FGD included five to 10 community people experiencing and/or caring for family members with NCDs and their metabolic risks. The purpose of FGD was to capture negotiated views on NCDs and metabolic risks as experienced by individuals, families and community members belonging to different socio-economic groups. Therefore, two FGDs were conducted in each VDC/municipality with one FGD conducted in a socio-economically disadvantaged community and the other in an advantaged/mixed community. The FGDs were facilitated by the first author with the help of local Female Community Health Volunteers and all FGDs were recorded after obtaining informed consent. FGDs were conducted in Nepali. The time of an FGD ranged from 45 minutes to one hour.

The interviews and FGDs audio recordings were first transcribed in Nepali and then translated into English for coding and thematic analysis. The research team utilised the *Framework Approach* to carry out the thematic analysis guided by the study framework (169). *Dedoose (Socio-cultural Research Consultants)* (170), a web-based data management platform, and *MS Excel 2016 (Microsoft)* (171) were used to manage the qualitative data and facilitate the analysis. Three sense-making workshops, one in each case district and one at national level, were conducted in 2018 to obtain feedback and suggestions on the preliminary findings from the local stakeholders. Ethical approval for this study was obtained from the Massey University Human Ethics Committee (SOA 16/37) and Nepal Health Research Council Ethics Committee (Reg. no. 163/2016) respectively. The participants were clearly informed about the purpose and voluntary nature of the study as well as the research team using a simple information sheet. Written consents were obtained from all participants involved in the study.

Results

Three significant themes relating to individual and community experience of NCDs and metabolic risks emerged through the analysis.

Everyone is experiencing the rising burden of NCDs and metabolic risk factors, both in urban and rural areas

Almost all key informants and focus groups participants shared that their communities were experiencing a rapid increase in NCDs such as cardiovascular diseases, cancer and diabetes and their metabolic risks, particularly hypertension, hyperglycaemia and high cholesterol. A FGD participant from urban Bhaktapur stated:

> *"Here, many people are suffering from sugar (Diabetes). Amrita and many others have sugar. They had sugar earlier than I had." (ID: 71)*

An FGD done in a rural Indigenous community in Morang district revealed that just as many people were suffering from hypertension in their communities.

> *"In the house of about 4 members, 3 people have high (blood) pressure." (ID: 67)*

Another commonly discussed concern by both policy and local level key informants was how the burden of NCDs was affecting the younger population. Hypertension or hyperglycaemia were previously unheard of in younger adults (under 40s) in those communities as well as Nepal. A policy level key informant added:

> *"Increase in blood pressure with increasing age and increasing blood pressure at young age is quite different things. We have been observing high blood pressure in people below 20 years of age." (ID: 5)*

Almost all participants raised strong concerns about the how key behavioural risks of NCDs such as junk food habits, tobacco and alcohol consumption, and physical inactivity were increasing. An FGD participant from rural Bhaktapur observed the negative influence of junk food on the traditional dietary practice, even in rural settings.

> *"We used to have fried corn, soya bean and stuffs like that. But we now have noodles [Pre-packed noodles]." (ID: 76)*

Participants also reflected on the contribution of tobacco and alcohol use in increasing the burden of NCDs. The use was facilitated by the easy availability of those products in both rural and urban areas. A community level key informant from rural Morang shared:

> *"You are asking about shops where cigarette isn't found. Cigarette is found in each and every shop but not all shops sell drinks." (ID: 64)*

Experience of NCDs and metabolic risk factors by disadvantaged groups is worse than that of advantaged groups

NCDs were affecting everyone irrespective of socio-economic status. However, the degree of exposure and vulnerability was reported differently among the advantaged and disadvantaged groups. Key informants discussed frequently how disadvantaged groups were more exposed and vulnerable to the risk of NCDs and how these groups had limited ability to change their socio-economic circumstances influencing their choices and behaviours linked to NCDs. A policy level key informant described:

"If a poor has a sedentary lifestyle, and even if he is made aware, it is very difficult for him to take corrective action due to his social circumstances. Like you see in malnutrition chain, a poor is circled by different disadvantages keeping him in vicious cycle." (ID: 15)

Participants indicated that disadvantaged groups gave less priority to their health, possibly due to low awareness and socio-economic circumstances. A Female Community Health Volunteer from Bhaktapur shared how a disadvantaged rural community reeling under underemployment and low socio-economic progress was experiencing a rise in addictive behaviours and possibly NCDs:

"Typical drinking start from the morning and will continue till evening as many people are unemployed and gather in such local shops and discuss about charm of foreign employment and politics. No wonder the problem (NCDs) is increasing in our communities." (ID: 33)

A rural health worker from Morang highlighted poor dietary practice among the disadvantaged groups and possible linkage to increased metabolic risks among them.

"The maximum number of patients in OPD belongs to Magar community and Rishidev community [Disadvantaged Groups]. They don't eat balanced diet and Magars eat more fatty food like pork meats." (ID: 61)

Further, long duration of NCDs progression often resulted in recognising one's risk of NCDs and accessing services for the prevention and treatment of one's health conditions at the late stages among disadvantaged groups. In particular, socio-economic circumstances deterred the disadvantaged group in seeking timely treatment of their

health conditions due to the fear of catastrophic health expenditures. A key municipality level key informant shared:

> *"If they [Disadvantaged Group] get checked up then new disease will come up and then this will increase tension." (ID: 44)*

Further compounding the vulnerability to the stresses of poverty and low awareness was key informants frequently describing the disadvantaged groups' access to public health services as being very limited. A policy level key informant elaborated:

> *"If we further look deeper into the system, our health system has not been able to reach the lower tier. We need to ensure and be capable that the basic minimal services reach to unreached and marginalised groups." (ID: 3)*

In contrast, advantaged groups have increased access to services, which has decreased their vulnerability to NCDs and widened the health inequity gap in the Nepalese context. A policy level key informant described:

> *"The reason for decreasing disease burden among rich is because of timely availability of treatment, physical activity, healthy diet, periodic health check-ups, health awareness. Rich people undergo treatment even when they see minor symptoms." (ID: 4)*

Gendered experience of NCDs problem

Gendered experience of the NCDs problem was observed during both interviews and focus groups. Females were much less likely to know their NCD risk status compared to males. A female FGD participant from rural Morang stated a common expression as follows:

> *"I don't know mine since I have never taken measurement." (ID: 67)*

Another experience shared by a key informant from urban Morang was that women often accessed services at the very late stages of metabolic symptoms relating to NCDs.

> *"Males generally go for checking their pressure level while females go after they encounter problem." (ID: 59)*

This delay in accessing preventive services could be related to the widely prevalent gender discrimination in Nepalese society, which was reflected upon by a key informant from rural Morang.

> *"This [Gender] discrimination is prevalent everywhere. This is not only the problem of poor and lower caste people but also prevalent among the rich and higher caste people." (ID: 53)*

Some key informants noted that the effect of gender discrimination was readily reflected in access to and use of health services. A vivid example of the impact of cultural norms was in the way that men could easily access health services while women needed to seek approval from male members or elders. A key informant from urban Bhaktapur elaborated:

"Due to this discriminatory and dominating cultural norms, female do not go to treatment often unless serious. They also have limited outside knowledge including food and calorie related information." (ID: 44)

Discussion

This study indicated that NCDs are growing in Nepal with geographic location, socio-economic status and gender influencing the vulnerability and exposure of different population group to NCDs. National surveys and research have indicated the increasing prevalence of NCDs and metabolic risks among adults in both urban and rural areas (9, 11, 178-180). The STEP survey of 2014 showed that NCDs metabolic risks were only slightly higher in urban areas compared to rural areas in Nepal, particularly, diabetes and obesity (179). However, these quantitative surveys do not highlight the lived experiences and vulnerability of the poor, rural communities and women or critically discuss the linkages of those experiences with social and commercial determinants of NCDs. This paper complements the national surveys by illuminating how the local context influences community experiences of NCDs and their risk factors.

Urbanisation and rural-urban interaction facilitating rise in NCDs

Our study demonstrated that the rural population as much as urban population experienced NCDs. A possible explanation could be that rapid urbanisation is occurring in Nepal (181), which is facilitating rural-urban interaction and transference of urban influences into rural areas of Nepal. In particular, junk food and inadequate physical activity-based urban lifestyles are gradually being introduced to the rural environment due to urban-rural movement, hence nurturing similar businesses and lifestyle as noted in rural areas of the case districts. Research in India has documented findings that diets

in rural India may be transitioning towards urban dietary practices due to increased urbanisation and urban-rural interaction (182). In addition, the availability and accessibility of junk food in many low- and middle-income countries have been well noted (125). In this study, participants did report that junk food companies have overwhelmed the market of both urban and rural areas in the case districts and communities are falling victim to their marketing strategies and developing junk food habits, especially among children.

The study also reported that tobacco and alcohol products were widely available and consumed in the case districts, resulting in an increased prevalence of NCDs. Tobacco and alcohol products have a cultural significance in the context of Nepal (183, 184). With the commercialisation of tobacco and alcohol products, the consumption of these products has further increased in both urban and rural areas (183). A Lancet review has critically analysed how these commercial motives of tobacco, alcohol and junk food companies are driving behavioural risks associated with increasing burden of NCDs (125). This commercial motive could explain the increased consumption of tobacco and alcohol, especially among young people, who have developed drinking and smoking habits due to easy availability. This has been further bolstered by limited monitoring activities from the respective authorities (185, 186). Authorities have not been able to strictly monitor the production and sales of tobacco and alcohol products as per the regulations. Evidence from India also suggests that alcohol companies are driving the drinking patterns among the young population in both urban and rural areas through marketing and influences at policy level (187). Overall, increasing rural-urban interaction is facilitating the increasing influence of commercial determinants in blurring the boundary of the concentration of NCDs in rural and urban areas of Nepal.

The multiple challenges impacting disadvantaged communities and their risks of NCDs

A disadvantaged community, in terms of socio-economic conditions and ethnicity, usually lies in the fringes and/or deprived areas of the villages/cities. The disadvantaged communities in particular have difficulty in accessing the public health services due to distance and socio-economic barriers (188). In this study, disadvantaged groups were often unaware of their metabolic risk status, resulting in delayed treatment of the conditions. Evidence from Nepal has shown that disadvantaged groups often have limited health literacy and service utilisation rates (189, 190). Further evidence from LMIC has indicated that young people and adults from these disadvantaged backgrounds are more likely to fall into the habit of smoking tobacco and consuming alcohol at an early stage due to stressful circumstances and get caught into the vicious circle of addiction and poor health (191, 192).

Furthermore, this study found that NCDs posed a significant financial burden to the families of the patient and deter individuals from disadvantaged groups from seeking care. A qualitative study in Uganda showed that due to pressure of meeting the basic needs and fear of catastrophic expenses, the disadvantaged group at risk perceive themselves at low risk of NCDs and delay the check-up and treatment (193). Health is considered as a need that can be delayed until any obvious disease occurs, which is complicated by the socio-economic circumstances and access to health services. Importantly, a lack of social safety protection within Nepal and similar LMIC may be preventing the vulnerable group from knowing their status of NCDs and getting themselves treated (194). In addition, government facilities in Nepal provide limited

NCDs-related services and private sectors are often expensive and out of reach for the poor (178).

Gender inequality and its impact on NCDs risks

This study has indicated that women cannot access NCDs-related services they need when they want them. Men can access any health services easily and without having to seek anybody's consent whilst females must seek approval from a male member or mother-in-law. Evidence from Nepal has shown that women have limited access to health services due to their low social status (195, 196). Due to their subordinate role and their family responsibilities, women often hesitate to seek care for their problems in the early stages of development of NCDs. These observations are common throughout the South Asia region and are linked with gender discrimination that a woman faces throughout her lifecycle (197). The participants in the study shared that gender discrimination was widely prevalent with sons getting better care and opportunities compared to daughters. Males are considered as breadwinners and future investment for the families, leading to preferential treatment of male children and neglect of female children (198, 199). In particular, the limited quality education opportunities for a girl child in her early years has a flow-on effect on empowerment and financial independence, often resulting in early marriage and early pregnancy (200). As a result, males have more autonomy and control of financial resources compared to females (201, 202). Comparatively, urban women, who tend to be more educated and economically active, are more autonomous in terms of decision-making and health service utilisation yet they also endure some form of dominance by men. Studies in Nepal have shown that women's autonomy was influenced by education status, income

level and age of the female, with patriarchal construct driving these root causes of female disadvantages (40, 203).

A key limitation of this paper is that the results and analysis were based on the limited data available from the first author's PhD study, which had broader scope (assessing situation, exploring behavioural risks, and their interaction with social determinants and modelling). The other notable limitation was limited participation of non-health stakeholders during the sense-making workshops, which may have affected the quality of feedback obtained during the workshops.

Conclusion

This study was able to highlight some of the key social determinants such as age, geographical location, socio-economic status and gender that are influencing the NCDs epidemic in Nepal. NCDs were widespread in both urban and rural areas and needed an urgent multi-sectoral response. Particularly, disadvantaged groups group were the most vulnerable and the worst affected from NCDs. There is a need to monitor the exposure and vulnerability of rural residents, women and the poor to NCDs and their metabolic risks. This is further impeded by a disconnected and under-resourced health system. The findings of this study strongly indicated that lack of policy action for preventing NCDs and their social and commercial determinants is contributing to the escalation of NCDs problem in Nepal. The paper reiterated the importance of understanding the complex issue of NCDs from the social determinants of health perspective. Social determinants of health framework proposed by World Health Organization could be one of the many tools that could be utilised to understand complex problems like NCDs and initiate public health intervention to prevent NCDs.

Paper 2: "Tobacco and alcohol use are playing critical role in the interaction of social determinants of non-communicable diseases in Nepal": a systems perspective

Paper 2 describes the role of tobacco and alcohol use in the interaction of social determinants of NCDs in Nepal from a systems perspective. Tobacco and alcohol use had a similar causal mechanism and therefore have been discussed in an integrated way. Five key thematic areas relating to tobacco and alcohol use emerged, which described a range of social determinants including addiction and misconception of tobacco and alcohol products, declining community capital, gendered constructs, socio-economic status and health system. Tobacco and alcohol use and addiction were a key mediating factor linking broader social determinants (social, economic and political context) to NCDs in Nepal as depicted in the CLD within the article.

This paper has been submitted to Biomed Central Public Health journal.

Abstract

Background: Tobacco and alcohol use are major behavioural risks in LMIC like Nepal that are contributing to a rapid increase in non-communicable diseases (NCDs). This causal relationship is further complicated by the multi-level social determinants such as socio-political context, socio-economic factors and health system. A systems approach has potential to facilitate understanding of such complex causal mechanisms. The objective of this paper was to describe the role of tobacco and alcohol use in the interaction of social determinants of NCDs in Nepal.

Method: The study was a qualitative study design guided by systemic intervention methodology. The study involved key informant interviews (n=63) and focus group discussions (n=12) at different levels (policy, district and/or community) and was informed by the adapted *Social Determinants of Health Framework*. The data analysis involved a case study-based thematic analysis that used a framework approach and development of causal loop diagram. The study also involved three sense-making workshops with key stakeholders.

Results: Five key interacting themes emerged during the data analysis. Habit and misconception relating to alcohol and tobacco use were contributing to the use and addiction of tobacco and alcohol. Low focus on prevention by health system further contributed to the problem. Decline in community capital and gendered social constructs influenced tobacco and alcohol use. Socio-economic status of families/communities was discussed as a potential root cause of use and addiction of tobacco and alcohol. These interacting themes were utilised to develop iterative causal

loop diagrams showing the influence of tobacco and alcohol use in the interaction of social determinants of NCDs in Nepal.

Conclusion: Tobacco and alcohol use and addiction causally linked broader social determinants (social, economic and political) to NCDs in the context of Nepal. These causal loop diagrams showed how socio-economic circumstances were influencing addiction and availability of tobacco and alcohol products in Nepal. A multi-sectoral response led by health system is urgently needed.

Background

Tobacco and alcohol use are major behavioural risks contributing to rapid rise in non-communicable diseases (NCDs) in LMIC like Nepal (3, 179, 204). The evidence from Nepal has consistently shown that tobacco consumption (31%) and alcohol use (17%) are high and linked to poverty, illiteracy, low-skilled occupations (179, 183), and other recognised social and commercial determinants of health (4). Nepal has strong tobacco and alcohol control policies, yet it continues to experience a high level of tobacco and alcohol use, especially by disadvantaged groups. HIC like Australia and New Zealand are leading in their efforts to control tobacco and alcohol among their disadvantaged groups by taking action on the social determinants of tobacco and alcohol use (205-208). In particular, they are employing the social determinants approach to address the issue of health inequity and substance abuse among their Indigenous population who are historically disadvantaged and marginalised. However, these countries have gradually aligned their policies and programmes towards reducing the current gaps in the health status between Indigenous and non-Indigenous groups through actions on social determinants of health. Nepal, which has substantial issues of health inequity among its sub-population, can reap the benefits by learning and adapting from the approach adopted by the HIC.

Systems science approaches are increasingly applied to understand and tackle multi-level, complex problems in population health (146, 147). A systems perspective on complex problems emphasises an understanding of how outcomes are emergent and generated from the dynamic interaction of multiple internal parts as well as the impact of external environment determinants on these internal parts. Experts argue for its potential application in public health as it provides a basis for richer understanding,

adaptation and continuous learning and reflection (150-152). Systems methods and tools are well suited for illuminating the dynamic structure and emergent behaviour of complex health problems like tobacco and alcohol use. While systems science approaches have been increasingly utilised for understanding and modelling complex public health issues in HIC that are generating compelling evidence for policy actions (147, 154-156), there are far fewer instances of their application in the LMIC context (158, 159).

What is needed urgently is a way to foster critical, context-specific dialogue about the interdependent relationships among these social determinants, tobacco and alcohol use, and the unfolding burden of NCDs in Nepal. With improved understanding of the impact of social determinants on the health of the Nepalese by utilising a systems thinking approach, effective public health policies and practices can be enacted and translated into action to reduce these behavioural risks (125). The objective of this paper is to describe the role of tobacco and alcohol use in the interaction of social determinants of NCDs in Nepal from the systems perspective.

Method

The overall study design was qualitative (figure 5) and informed by systemic intervention methodology (SI) (162). SI adopts critical systems thinking and stresses use of multiple methods. Critical systems thinking has aims to address the asymmetric power relations among stakeholders in addressing complex issues such as NCDs, which disproportionately affect disadvantaged groups. In this study, involvement of disadvantaged stakeholders and ensuring their meaningful participation helped illuminate the NCD problem from the critical systems perspective.

A combination of two methods were applied: case study (163) and system dynamics (152). These methods complement each other and critically informed the study design to address the research question. The case study method framed the scope of qualitative data collection and analyses to understand the generative mechanism of the NCDs problem. Subsequently, system dynamics was used to design causal loop diagrams (CLDs), which depicted the causal linkages identified through case study analysis and simultaneously improved the case study analysis by providing additional insights on causal mechanism.

Case study

Study area and participants: Two case districts were purposively selected from two district geographical regions of Nepal: Morang district from Terai (plain) region and Bhaktapur district from Hill region. The case study involved key informant interviews with district and village level stakeholders and focus group discussions (FGDs) with community people. The district and Village Development Committees (VDCs) /municipality level key informants were identified through consultation with District Public Health Offices and included participants from District Health Office, Local Development Office, local non-government organisations (NGOs), Primary Health Centres, health posts, local schools and Village Development Office. One municipality and two VDCs from each case district were selected for interviewing key local stakeholders: Madhyapur Thimi Municipality, Dadhikot VDC and Sipadol VDC from Bhaktapur district, and Biratnagar Municipality, Tankisinwari VDC and Bahuni VDC from Morang.

The District Public Health Offices helped to identify two communities (one advantaged and other disadvantaged communities) within each VDC/Municipality for focus groups discussions (FGDs). Local health workers and Female Community Health Volunteers supported the primary researcher in the planning and conducting of focus groups in the target communities.

Policy level key informant interviews were conducted to supplement the case studies and comprised of multi-sector participants involved in formulating the *Multi-sectoral Action Plan for the Prevention and Control of NCDs 2015–2020* and participants from NGOs and academia. The participants recruited for key informant interview varied in terms of work place, years of experience, sectors (health as well as non-health) and expertise (implementation as well as policy level). The study adopted a "maximum variation" sampling strategy to collect perspectives relating to NCDs issues from across the sectors (168).

Study tools: The study tools (interview schedule and focus group guideline) were developed following the study framework adapted from the social determinants of health framework of the World Health Organization (figure 3). The study tools were extensively discussed in light of the adapted framework by the research team. The tools were first developed in English and translated into Nepali. The research team took the opportunity to rearrange the questions in the schedule based on the experience of first few interviews to improve the quality of interviews and FGDs.

Data collection: The data collection was conducted for four months (July–October, 2016) based in Nepal. The first author interviewed 39 key informants from the two case

districts and 24 key informants from policy level. The time of interview ranged from 30 minutes to one hour. The first author simultaneously started the district and community level data collection at Bhaktapur district and at policy level. The data collection in Morang district started after the completion of the majority of the interviews and FGDs at Bhaktapur and policy level. Some interviews with policy level stakeholders were completed towards the end of data collection period due to scheduling issues.

The first author conducted 12 focus groups in six selected VDCs/municipalities from the two cases districts involving five to 10 community people affected by and/or caring for family members with NCDs metabolic risks. In each VDC/municipality, the first author conducted two FGDs where one group represented disadvantaged communities and the other advantaged/mixed communities. The FGDs were facilitated with the help of local Female Community Health Volunteers. The time of an FGD ranged from 45 minutes to one hour.

The audio-recordings of interviews and FGDs were first transcribed in Nepali and then translated into English for coding and thematic analysis. The translation was carried out by two public health graduates from Nepal and was regularly supervised by the first author. Open descriptive coding, guided by the study framework, was done by the first author in *Dedoose (Socio-cultural Research Consultants)* (170), a web-based data management platform. The first author coded a few interviews first and compared the transcripts for consistency and clarity in coding. The final codes were then grouped and charted in an *MS Excel 2016 (Microsoft)* (171) based on the study framework, and major themes and causal linkages were interpreted and iterated. The research team

utilised the framework approach to code the themes and carry out the thematic analysis guided by the study framework (figure 3) (169).

Causal Loop Diagramming

The causal linkages and mechanisms identified through case study were depicted in the form of CLDs, a qualitative approach used in system dynamics modelling to identify feedback structures that illustrate causal influences for a given problem of interest. A CLD depicts a systems problem by showing causal variables interconnected with arrows denoting causal influence (mechanism) among variables. The convention/analytical strategy to develop the CLD in this research has been adapted mainly from a key system dynamics resource, namely *Business Dynamics* (152). CLDs comprise two kinds of loops: balancing and reinforcing. The balancing loop is a goal-seeking loop, which is indicated by "B" within CLD, and indicates the stabilising feature of the loop. Generally, loops consisting of health intervention variables (health education campaign, screening, treatment, etc.) that try to bring down the magnitude of health problems are examples of balancing loops. Reinforcing loop (indicated by "R" within CLD) involves action that produces a result that triggers similar actions resulting in growth or decline, for example the vicious cycle of poverty and illness. These loops are further explained in the results section in the context of this study. The CLD was built using *Vensim (Ventana Systems Inc.)* (172).

Stakeholder Validation

Stakeholder validation was conducted through organising three sense-making workshops, two at respective case districts and one at national level during January/February, 2018. The workshops helped to further enrich the analysis through

the feedback and suggestions from the stakeholders. These workshops, indeed, became opportunities to sensitise the stakeholders about the tobacco and alcohol issues in Nepal. The research team believes these workshops proved useful in reaching the purpose of this research and the methodological stance of SI methodology.

Ethical consideration

Formal ethical approvals were obtained from the Massey University Human Ethics Committee (SOA 16/37) and Nepal Health Research Council Ethics Committee (Reg. no. 163/2016) respectively. Clear explanation about the purpose of the study and voluntary participation, using a simple-to-understand information sheet, was provided to all participants and, in particular, disadvantaged groups. A prior informed and written consent was also obtained from all participants for semi-structured interview and focus group discussion.

Results

Five key interrelated thematic areas relating to tobacco and alcohol use emerged from the data analysis, which were utilised to develop a collection of CLDs to elucidate feedback structures of interest. These interrelated themes described a range of social determinants operating at different levels (family, community and societal levels), including addiction and misconception of tobacco and alcohol products, declining community capital, health systems issues, gendered constructs and socio-economic status.

Theme 1: Addiction and misconception related to alcohol and tobacco use contributing to increased risk

Awareness of the impacts on health of tobacco and alcohol use was widely present among general population, both in rural and urban areas, according to key informants and FGD participants. However, despite having knowledge about the risks of smoking and drinking, people continued to indulge in these risk behaviours, most likely due to addiction. An FGD participant from rural Bhaktapur explained:

> *"It is actually the addiction that plays a role here [for smoking and drinking habit]. If you do not smoke for some time, then you feel like something's missing, that's it. It is similar to the condition where a drug addict acts like a crazy [person] if he doesn't get some." (ID: 76)*

Participants reported that adults from the study areas had been exposed and were addicted to such products, often at a younger age. Some key informants shared a perception that the problem was getting worse in younger age groups, with younger groups widely using the tobacco and alcohol products. Young people could access any liquor or tobacco shop to buy alcohol and tobacco products, with no questions asked. A health worker from urban Bhaktapur stated:

> *"8–9 class students smoke tobacco who can get them easily from the shops." (ID: 42)*

Young people would often start smoking and drinking alcohol due to peer pressure and imitating the behaviour of an adult, and gradually become addicted to its use. When something addictive is easily available, such an environment encourages young people

to experiment with it, leading to addictive habits. A key informant from rural Morang shared:

> *"And then, we have alcoholism and smoking growing trend especially among students and young people. There is peer pressure to drink and smoke. These students hide and smoke." (ID: 54)*

Participants reflected that addiction was linked to families and communities facing interrelated stresses relating to economic hardship, unemployment and family violence, and was often driven by misconceptions. Participants shared many misconceptions relating to tobacco and alcohol use. A very common misconception was that tobacco and alcohol relaxed and reduced physical and mental stress, which was viewed as influencing uptake and use of tobacco and alcohol. A health worker from rural Bhaktapur explained:

> *"Increasing stress due to unemployment and lot of leisure time expose people to bad habits at early age." (ID: 35)*

An FGD participant candidly shared:

> *"Not only smoking alleviates tiredness, if one smokes, then one gets some rest from work." (ID: 74)*

Theme 2: Low focus on prevention by health system contributing to tobacco and alcohol use and NCDs

Overall, there has been limited focus on system strengthening and preventative approaches for NCDs prevention. A curative orientation was dominant at both policy and implementation level, limiting preventative actions against NCDs. Resources gained from tobacco and alcohol taxes were often utilised for curative and other non-health budgetary purposes and not for preventing tobacco and alcohol use and addiction.

> *"Finance Ministry do not provide enough resources [for prevention] despite huge amount is generated from health tax." (ID: 14; Policy level key informant)*

Weak monitoring and enforcement were contributing to unabated demand, production, marketing and availability of such products, leading to increased use and addiction of tobacco and alcohol.

> *"There is one investigation committee [at District Level] but it is not much active." (ID: 26; District level key informant; Bhaktapur)*

Both policy and district level participants also expressed that the district health system and below levels did not have any well-resourced programmes for preventing tobacco and alcohol use or in providing counselling support for those already addicted to tobacco and alcohol.

> *"These tobacco, tobacco products and drugs become addiction to people. We apply the prevention approach to those who don't consume these substances. For those who consume these substances, rehabilitation and counselling must be strengthened." (ID: 50; District level key informant; Morang)*

This lack of a focused policy structure and leadership for initiating NCDs prevention action was expressed by many policy level key informants. A policy stakeholder clarified:

> *"Curative Service Division is leading this fight against NCDs but more from curative perspective and less from Health promotion." (ID: 15)*

Further, another policy stakeholder emphasised effective utilisation of scattered resources for NCD prevention through structural reform at policy level.

> *"There is budget for NCDs prevention but are scattered in various places. That has to be managed through certain centre in an effective way." (ID: 12)*

Theme 3: Declining community capital/cohesion influencing tobacco and alcohol availability and use

Key informants and FGD participants suggested that community capital and cohesion were declining in the communities. An FCVH from rural Bhaktapur candidly stated:

> *"Community [is] not as cohesive and helpful as previously." (ID: 33)*

One FGD participant from rural Morang shared that families and communities were not supporting each other enough when advice was given that children and young people should not indulge in addictive behaviour.

> *"If somebody's son is seen smoking or drinking and other person tries to stop him saying why he is smoking, then his guardian will come and say- why do you care about my son? He eats whatever he wants." (ID: 67)*

Some actions were initiated by communities, especially women's groups, to reduce alcohol abuse, but they were often short lived due to the lack of support from male members and community leaders.

> *"We have tried to address this many times. But whenever women raise their voice against these, pub and shop owner quarrel with them. Police was sought for help but they didn't take any action." (ID: 56; Village level key informant; Rural Bhaktapur)*

Alcohol and tobacco were not considered a significant problem at community level by local authorities. This was illustrated when one of the district level key informants from Morang indicated that alcohol and tobacco-related issues never entered into the local planning agenda.

> *"Due to this, during planning process from the community level (planning must start from the community level) the issues regarding the prohibition of alcohol and tobacco products etc. aren't arisen while discussing about the plans." (ID: 50)*

Further, there has been very low interest from community-based social organisations in tackling alcohol and tobacco issues due to their widely pervasive nature within Nepalese society and possibly due to limited funding. A district level key informant from Morang reflected:

> *"In my 10 years career, till now only one organisation had been here with motto to control tobacco and alcohol." (ID: 50)*

On the supply side, local shop owners who often belong to same communities would take up the alcohol business (as supplier or seller) due to their own circumstances of hardship. An FGD participant from rural Morang stated:

> *"They [shopkeepers] say they won't make money if they do not sell alcohol." (ID: 68)*

Some key informants did share that despite alternatives to their business, the local shop owners were putting economic benefits before social and health benefits and selling widely, even to underage groups. A social worker from urban Bhaktapur explained:

> *"And why would business people think before selling; those college students are the source of profit. Profit margin is high in alcohol and cigarettes. Ethics and values are neglected by such business owners." (ID: 44)*

Local key informants also indicated that homemade alcohol producers used hazardous methods to amplify alcohol strength, which would serve as a means to attracting more customers. Some producers were mixing chemicals and toxic substances that are hazardous and playing with public health for economic gains.

> *"What I have heard is that they use inedible substances including animal remains. They try to make strong alcohol using urea fertilizer. That can severely affect our health." (ID: 76; FGD participant; Rural Bhaktapur)*

Theme 4: Gendered social constructs and power differences influencing tobacco and alcohol use

Tobacco and alcohol use were reportedly as being implicitly driven by gendered social constructs and power differences. Study participants expressed that it was mainly males within their communities that demonstrated addictive behaviours.

> *"And, mostly the household head, male members are addicted to such alcohol and tobacco." (ID: 39; Village level key informant; Bhaktapur)*

Local level key informants further indicated that this situation of widespread addiction among male members could be linked to a combination of factors, including relieving stresses, financial autonomy of male members and low social status of females. Males had more autonomy and control of finances and consumed tobacco and alcohol products at their will in the context of the case districts.

> *"Male are more intensely involved in alcoholism. They earn money during daytime and spend it on drinks at night. This problem is more intense among 6-7 households in our locality. Even domestic violence is common in those houses." (ID: 56; Village level key informant; Morang; Health)*

A female FGD participant from rural Morang was vocal about the increased stress on women due to the drinking habits of male members and their inability to do anything to address it.

> *"You males drink, smoke and this problem [hypertension and diabetes] is because we take stress about that." (ID: 67; Female FGD Participant; Rural Morang)*

This power imbalance can be linked to the prevalent gender discrimination and disempowerment of women engrained in Nepalese socio-cultural practices. Participants reported that the gender discrimination was still prevalent in hidden forms in all sections of society.

> *"There is still discrimination but in a hidden way but it is quite less than what was in the past." (ID: 41; Municipal level key informant; Bhaktapur)*

Interestingly, some key informants noted an increasing trend in the tobacco use and alcohol consumption among females. A policy level key informant further stressed that national data may be underestimating the number of female smokers but in reality, there has been a rapid increase in the number of female smokers.

> *"We can clearly observe significant number of women involved in smoking and tobacco consumption especially in rural areas. But our national data have shown less prevalence in females." (ID: 5)*

The policy informant further added that the underestimation of female tobacco users might be due to Nepalese socio-cultural expectation of the behaviour of the female, which is rooted in the patriarchal social construct.

> *"There is the perception in our society that females shouldn't be consuming such substances and so females do not give true answers and also our enumerators may not have been able to explore effectively." (ID: 5)*

Theme 5: Socio-economic status as the root driver of tobacco and alcohol use

The socio economic-status was reported to have the cross-cutting linkage with tobacco and alcohol use in the case study districts. Key informants stressed that alcohol and

tobacco consumption were a major community problem, especially among low-income groups.

> *"It is also a major problem. Since maximum people works in factories, they use tobacco and alcohol." (ID: 61; Village level key informant; Morang)*

Key informants shared some key reasons for the addiction of alcohol and tobacco products among lower income groups, which, in turn, affected their financial status. A district level stakeholder explained:

> *"In disadvantaged community where there is poverty; people do labour work and smoke cigarette during break, and that is actually their resting time." (ID: 26)*

Further, alcohol and tobacco were often seen as a way to ward off stress and tiredness, especially by low-income groups. A village level stakeholder elaborated:

> *"Most of the people here are engaged in labour work. They have to do hard work like carrying stones and get tired and do not even eat their food on time. In the evening to get rid of their tiredness, they consume alcohol." (ID: 37; Bhaktapur)*

Study participants indicated that there were many shops selling alcohol and tobacco in major junctions and shops and most of them were from low-income groups. These low-income community members started the local business of selling alcohol and tobacco products due to lack of job opportunities and high profit margins from tobacco and alcohol products.

"However, these home-made alcohols are the means to earn money for the small shops and poorer households." (ID: 55; Village level key informant; Morang)

Interestingly, there was blurring of the boundaries between traditional drinkers (Gurung, Rai, Magar, Newar and similar ethnicities who are culturally allowed to drink alcohol), collectively referred as *Matwali*, and traditional non-drinkers (Brahmin, Chhetri and similar ethnicities who are culturally forbidden to drink alcohol), collectively referred as *Tangadhari,* which was leading to increased alcohol consumption in Nepalese society. Participants reported that drinking among traditional non-drinkers has significantly increased due to modernisation and the socio-cultural changes.

"There was social rule that it is something to be consumed by Matwali but not by Brahmins and Chhetris but now the situation has just reversed… These days it is hard to find Brahmin/ Chhetris who do not drink." (ID: 47; District level key informant; Morang)

Alcohol is very much ingrained in the cultural practice of the *Matwali* ethnic group; they require alcohol for their each and every cultural practice for birth, marriage or death. Due to the socio-economic circumstances of socially disadvantaged *Matwali* communities, many houses in such *Matwali* communities were involved in home-brewing and would supply the alcohol to a number of shops around the locality and nearby cities.

"Every morning people sell more than 100 litres of alcoholic drink. The (specific ethnicity) people brew whole night and sell to every shops without the fear of police." (ID: 36; Village level key informant; Bhaktapur)

Matwali were using their traditional skill for home-brewing at a commercial scale in order to improve their socio-economic conditions. One of the policy stakeholders explained the situation as follows:

> *"Matwali have cultural practice of brewing homemade alcohol and we do not infringe into that cultural practices. But, many have been exploiting this cultural aspect for economic benefits including those who were non-traditional brewers." (ID: 16)*

CLD of major sub-systems depicting the interaction of tobacco and alcohol use, other social determinants and NCDs

In an effort to present the themes from a dynamic systems perspective and gain insights on the interactions of the social determinants indicated by the themes, the research team developed CLDs to illustrate those dynamic interactions, or feedback structures, which were giving rise to the problem of NCDs in Nepal. The CLDs constitute three prominent feedback mechanisms or sub-systems displayed by sets of balancing and reinforcing loops that are possibly escalating the NCDs epidemic in the case districts. They are as follows:

Prevention delay sub-system. The prevention delay subsystem comprises of balancing loops (indicated by B at the centre of the loop), which indicates the goal seeking or stabilising nature of the loop (figure 9). The negative sign between "Government health system action" and "demand and supply" here means that increasing implementation of regulations and monitoring can decrease availability but the action is delayed (indicated by delay sign in the arrow i.e. //), resulting in increasing exposure of healthy population to tobacco and alcohol products that lead to metabolic risks and NCDs (links have

positive sign). This loop is the balancing loop as the loop has a goal i.e. to reduce the supply and demand of tobacco and alcohol products but is suffering significant health systems action delays. Themes indicated that the health system is failing to take any concrete actions against tobacco and alcohol problems, both at the community and policy level.

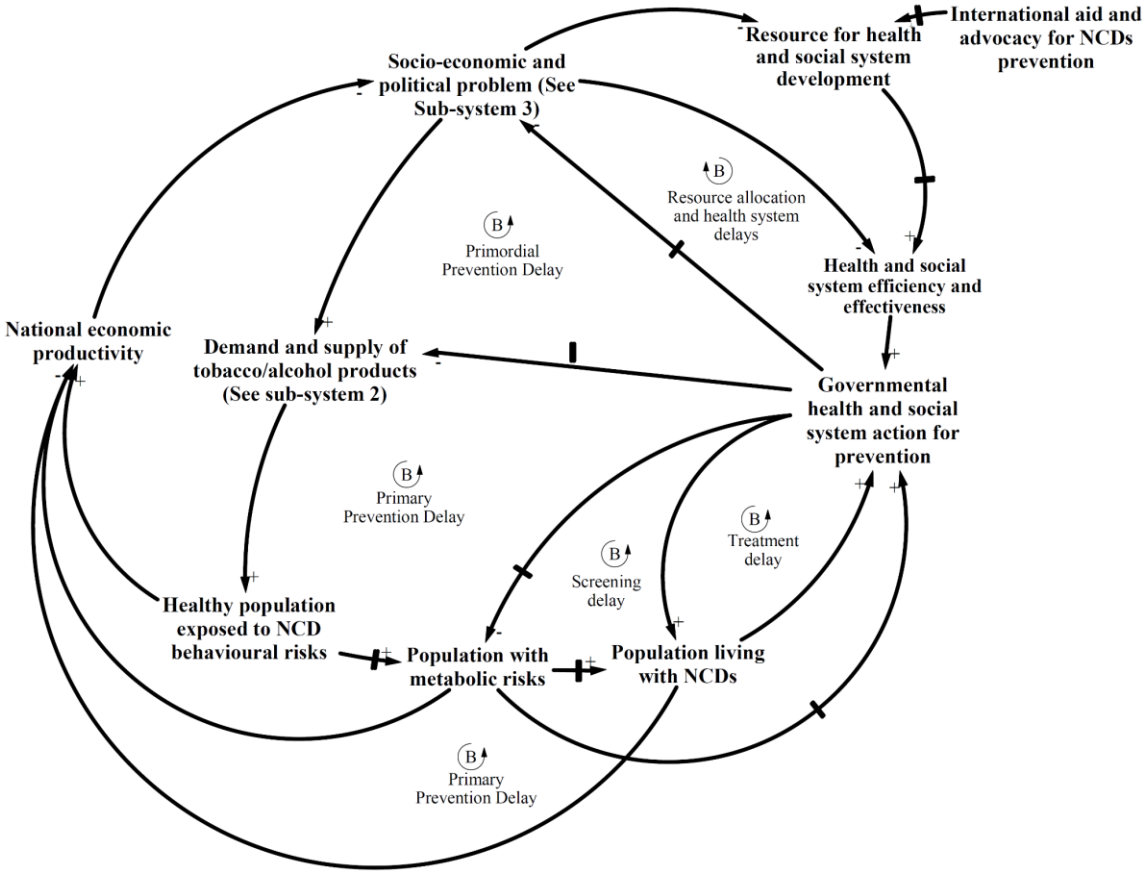


Figure 9. Prevention delay sub-system showing the interaction of governmental response to prevent tobacco and alcohol use, other sub-systems and NCDs

In one of the primary prevention balancing loops, the positive linkage (+ sign in the arrowhead) between “Demand and supply of tobacco and alcohol products” and “Healthy population exposed to NCDs behavioural risks” indicates that the increase in tobacco and alcohol use is contributing to the increase in metabolic risks and

subsequently NCDs. The increasing health effects in turn provide pressure to the authorities to initiate health system action. Here also, the positive sign between "Population living with NCDs" and "Health system actions" means the increase in health effects has increased health system action but with more emphasis on curative care and less on prevention.

Addiction-driven demand-supply sub-system. This sub-system mainly constituted of reinforcing loops showing how tobacco and alcohol use were leading to addiction and demand of such products in the case district of Nepal (figure 10). As discussed earlier, the companies that produce tobacco and alcohol make profits from the sales of such addictive products; hence it can be argued that they have financial capital for marketing and policy influences. Such influences can be linked to increased supply and availability exposing and pushing people into adopting risk behaviour in the case districts.

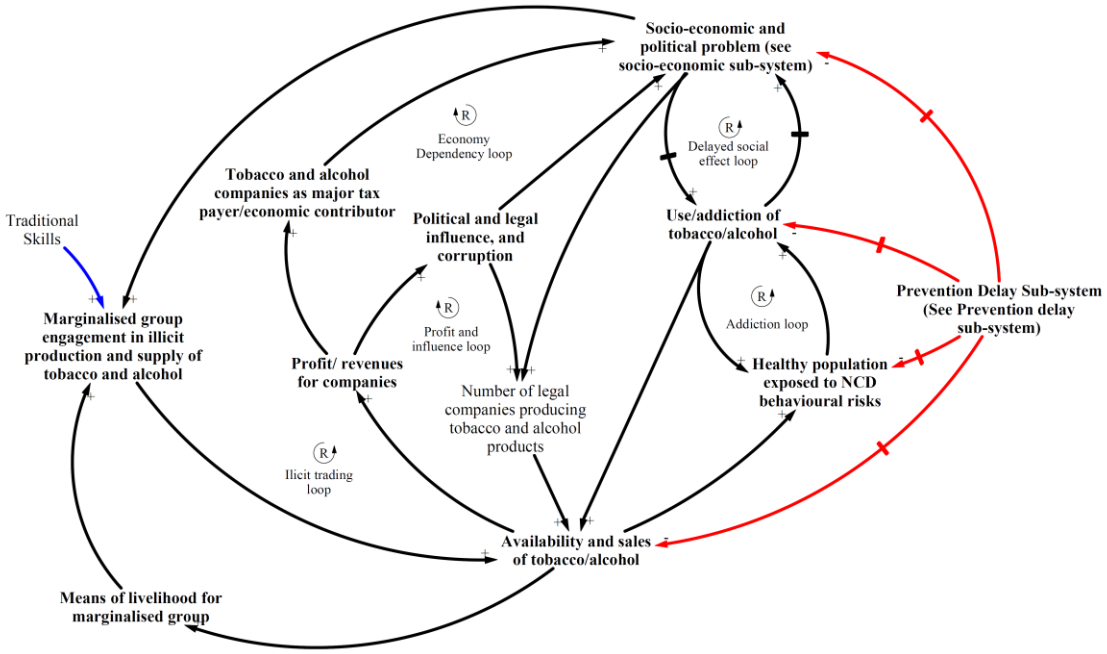


Figure 10. Demand-supply sub-system showing the interaction of availability and sales of tobacco/alcohol, other sub-systems and NCDs

A key reinforcing profit-and-influence loop can be seen in the middle of the above CLD, which indicates that the tobacco and alcohol companies utilise their economic power to influence policy, which is a macro-economic issue (hence negative sign). This is creating a favourable situation for the business and growth of such companies. As a result, tobacco and alcohol products are widely available and sold as a result of the increasing demand for such addictive products. Companies are able to maintain profit (positive sign) to continue funding their policy influence. Reinforcing loop (indicated by "R" within CLD) thus involves action that produces a result that influences more of the same action, thus resulting in either growth or decline.

Socio-economic influence sub-system. This sub-system contained reinforcing loops, which emphasised the social and economic influences contributing to the facilitation of a tobacco-and alcohol-conducive environment (figure 11).

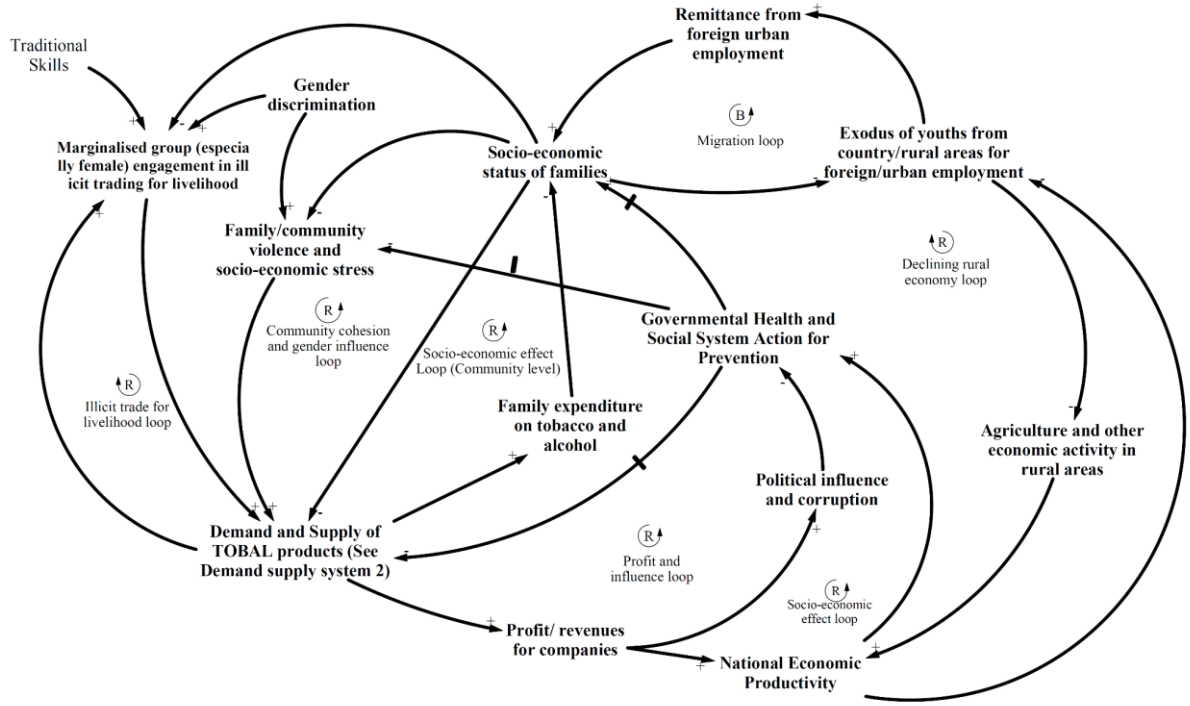


Figure 11. Socio-economic influence sub-system showing the interaction of socio-economic status, other sub-systems for tobacco and alcohol use and NCDs

Socio-economic hardship leading to experience of stress and family violence was linked with development of tobacco and alcohol addiction. Further, socio-economic situation in rural areas was resulting in youth migration to urban areas and foreign countries but was affecting the rural agriculture as well as the national economy. The effect on national economy can be linked to limited resources available for health and social sectors.

Discussion

The themes and three key interlinked mechanisms or sub-systems illustrated the dynamics of interaction of social determinants of NCDs mediated by tobacco and alcohol use in Nepal. This section presents discussion of the themes and insights from the causal loop models using system archetypes.

The use of and addiction to tobacco and alcohol products

In this study, the themes indicated that tobacco use and harmful alcohol consumption were common, particularly among disadvantaged groups. The CLDs representing all three sub-systems showed how social and commercial determinants of health are contributing to increased use and addiction of such products in Nepal. Wide use of tobacco products in various forms was reported in each of the case districts. Chewing of dried tobacco leaves was more popular in Terai compared to Hilly district where smoking was preferred. Such distinct practices based on geographical location have been observed in the national level surveys conducted in Nepal (180, 183). Tobacco and alcohol products have non-lethal addictive properties, which leads to the addiction of such products (209, 210). Studies have shown association among peer pressure, self-

interest, stress, availability, administrative actions and use of tobacco and alcohol across different contexts in Nepal, India and South Africa (186, 211-216).

The participants in this study repeatedly reported that smoking/drinking helped them relieve the feelings of stress. This reasoning has been noted in both developed and LMIC, especially among disadvantaged groups (217-220). However, evidence has indicated that in fact smoking increased stress as a result of cravings (221, 222). Limited knowledge, misconception and complacency were key factors in the communal understanding that alcohol and smoking/tobacco reduce the stress of an individual, a belief firmly held, especially among poor and vulnerable groups, and subsequently leading to addiction.

As shown in this study, the addiction of tobacco and alcohol products was more prominent among the low-income groups who would often spend significant amounts of money on tobacco and alcohol products. Further, smoking and alcoholism were socially and culturally acceptable in many Nepalese societies despite their addictive nature (223, 224). Evidence, at both the local and international levels, has strongly linked tobacco and alcohol use as key risk factors of NCDs and metabolic risks (179, 204, 225).

Successful marketing and influence of big companies

As indicated in the themes and depicted in the CLDs, tobacco and alcohol companies have been very successful in the marketing and sales of their products, resulting in increased revenue and financial ability to undermine public health policies and actions. In particular, tobacco companies target young people from LMIC (226, 227). Targeting youths has two benefits: 1) they can be easily influenced; and 2) once they start using,

they use the products for longer duration, as they are still young. Further, LMIC regulations are not as strict as HIC where policies and regulations on marketing and sales of such products have become very difficult. In particular, tobacco and alcohol industries argue that they contribute significantly to national income in many LMIC. As a result of this, it is difficult for LMIC to take any concrete steps against tobacco companies (227). However, anti-tobacco advocates counter-argue that tobacco companies are misguiding the government and in fact do not significantly contribute constructively to the national economy (228).

Health system challenges for prevention of tobacco and alcohol use

Addressing tobacco and alcohol addiction requires both health promotion actions as well as counselling and motivational support to the users to quit smoking and alcohol. This study indicated that these programmes were not focused and extremely limited. While HIC allocate significant resources for those wanting to quit addictive behaviour (229, 230), LMIC like India, Vietnam and China have limited concrete mechanisms in place (231-234).

Despite Nepal being among those countries with comprehensive tobacco and alcohol control laws and policies, the themes and CLD showed that poor regulation and enforcement were resulting in wider availability of tobacco and alcohol products. Similar findings have been noted in countries where the laws are poorly implemented (235-237). In contrast, countries (often HIC) where tobacco laws are strictly implemented, tobacco use has dramatically reduced (238). Tobacco and alcohol influences have been widely noted across the globe, particularly in LMIC where the system mechanisms are weak and can be influenced (125, 239). Inefficiency, poor

governance and lack of leadership within health and social systems have been often cited as main system issues in LMIC for addressing complex problems like tobacco and alcohol use (240-242). HIC have started to align their health and social system sectors for addressing such complex problems (82, 243). However, LMIC are still struggling to orient their health and social systems for addressing social and commercial determinants of health that are leading to continued marginalisation and social exclusion of already-excluded groups.

Gender power gap for disproportionate smoking and drinking among male

In this study, gender and socio-cultural factors were also found to be linked with tobacco and alcohol use at family and community levels. South Asian countries are patriarchal societies, with males enjoying more power and autonomy compared to females and therefore indulging in risk behaviour. Evidence showed males were overwhelmingly engaged in addictive behaviour compared to females (183, 244, 245).

Further, impacts of such addictive behaviours on female and children were also highlighted by the themes. In Cambodia, women and children were impacted by addictive behaviour in terms of violence and socio-economic stress, including health effects (246). Similar effects of violence and stress women and families face due to alcohol use by the men in families, particularly in low socio-economic groups, have also been seen in India and Bangladesh (247-250). A study in China indicated that women accepted the addictive behaviour of their husbands to maintain family harmony, which linked with the sub-ordinate and low status of women within the family (251). Another study also found that women experiencing violence take up addictive behaviours (252).

However, there may be underestimation of the female users of tobacco and alcohol products in Nepal as indicated in the current study. A paper by Mackay argued that female tobacco and alcohol users could be rising in LMIC due to gender empowerment, loosening of socio-economic constraints, and targeted campaigns by companies (253). Thus, the actual prevalence of tobacco and alcohol consumption among the female population could be higher in Nepal but could only be established through ensuring research being conducted in a socio-culturally appropriate way.

Social capital influencing tobacco availability and use

This study indicated that Nepalese society was increasingly becoming accustomed to an environment conducive to universal availability and use of tobacco and alcohol. Further, the favourable environment for tobacco and alcohol addiction, including their wide availability at local level, indicated a decrease in social capital and cohesion within communities. In this study, small businesses within Nepalese communities sold tobacco and alcohol widely without considering their impact on public health. Further, there was limited community action against rise of tobacco and alcohol businesses within communities. Increasingly, studies have shown causal linkage between community capital and cohesion and health outcomes (65, 66).

Poverty as root cause of use/addiction among disadvantaged groups

The themes and the CLD (sub-system three) have indicated that socio-economic circumstances of families have been the root driver of tobacco and alcohol use and, inversely, the increase in tobacco and alcohol use has led to income loss and economic challenges for families. Addiction often leads to huge economic losses (254, 255) and pushes individuals into a vicious poverty cycle. Similar to the findings of this study,

studies have shown that children and youths from such disadvantaged communities were often exposed to alcohol use at very early age (224, 256). Often, these children gradually drop out of school and join the non-skilled workforce with addictive behaviours and poor health. A longitudinal study suggested similar economic and health impact of alcohol on adults who were exposed to alcohol at an early age (257). The point here is that disadvantaged communities faced severe social and economic challenges to pull themselves out from the vicious trap of poverty and addiction.

While there was supposedly a high prevalence of homemade alcohol abuse in the traditional drinking ethnic group (*Matwali*), there appeared to be a rapid increase in alcohol consumption in the traditional non-drinking ethnic group (*Tangadhari*). This shift was noted in research carried out almost two decades ago in Nepal (224). This indicated that use and addiction of tobacco and alcohol products were mainly linked with socio-economic circumstances. Further, communities in Terai (Morang district is a Terai district) were more economically deprived compared to communities in hills (Bhaktapur is a hilly district) making communities in Terai more vulnerable to effects of tobacco and alcohol.

Illicit trading of tobacco and alcohol products was rife in both case districts. In line with our findings that disadvantaged groups were engaged in sales of alcohol and tobacco products, a review indicated that most of the small tobacco and alcohol businesses were often operated by low-income groups and opt to sell such products due to high demand and for livelihood reasons (183). WHO have reported that disadvantaged families within communities often sell tobacco and alcohol products in order to improve their socio-economic circumstances (192). In this study, *Matwali* ethnicities have been

utilising their traditional skills to produce and sell alcohol to overcome their financial situations in both case districts. These groups have been historically marginalised and often have poor socio-economic circumstances (258). Any action against such sales by disadvantaged groups raised both ethical and economic questions such as: Can the authorities take away the only means of their livelihood? Are the authorities able to provide any alternative to their business?

System archetypes and proposed applications of resultant CLDs

System archetypes are templates or simple versions of CLDs for understanding common problems or dilemmas in an organisation or system, and in a way that generates insights for action among stakeholders. The sub-systems and archetypes (figure 12) informed by the current case study are a starting point for critical dialogue and action in Nepal to understand and address the complex issue of reducing behavioural risks and in mitigating the burden of NCDs.

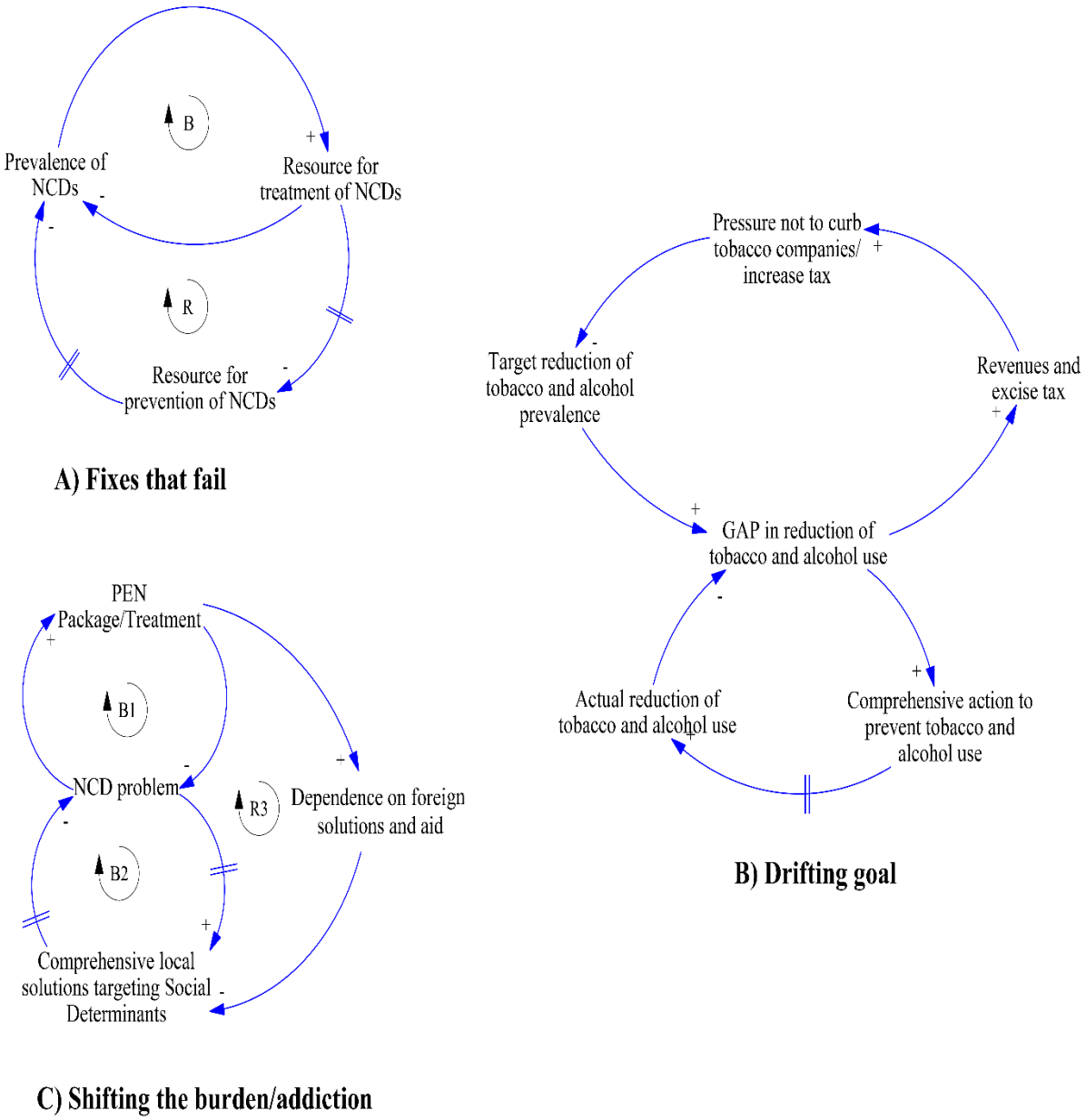


Figure 12. System archetypes showing different mechanisms of influence of tobacco and alcohol use on NCDs

The prevention delay sub-system resonates with *Fixes that fail* systems archetypes (259) (Figure 12 A). The health system of Nepal is based on a primary health care approach with its foundation being primary prevention of health problems. However, more resources are allocated towards treatment of NCDs (i.e. *treatment fix*), and as a result of

which prevention is receiving limited resources. The *treatment fix* is driven by two key reasons: urgent need of resources to support the increasing number of people being impacted by NCDs (such as cancer, chronic kidney disease and cardio-vascular diseases), and preference of treatment over prevention by the policy makers due to invisibility and time-lag nature of the effects of prevention. Over an extended time horizon, the *treatment fix* is only going to increase the prevalence of NCDs, as is currently happening in Nepal.

Drifting goal archetype (Figure 12 B) can explain a key phenomenon indicated by sub-system 2 (Demand-supply) whereby policy makers are not able to raise excise tax on tobacco products as per international standard due to the influence of tobacco and alcohol companies. While the prevention experts have been pushing for increasing excise tax recommended by WHO, they have limited resources and power, leading to delays in the implementation of comprehensive prevention measures.

Shifting the burden archetype (figure 12 C) provides a key insight from within the socio-economic sub-system. The archetype depicts the inability of health system to see the bigger picture or broader influences driving the NCDs problem. The health system has been focusing on narrow sets of interventions driven by foreign support and ignoring the complexity of the issue, which is embedded in the socio-cultural context and demanding local solutions. Therefore, local context-based multi-sectoral actions targeting the social determinants of health are needed.

In summary, the balancing effects of the health system in preventing NCDs have already been significantly delayed, leading to accumulation of burden of NCDs, so

accelerated action is needed from the health system to have any significant impact. Some key insights from the model and archetypes include the prioritisation of preventative action over curative actions and considering the social and commercial dimensions that are driving the addiction and use of tobacco and alcohol.

Study Limitations

There were some key limitations of the study. The study design and tools were guided by WHO's Social Determinants framework and therefore may have inherited the limitations of the SDH framework, including being broad and wider in scope. Some of the determinants that could not be sufficiently supported by the data included financial burden and their implications on the families affected by tobacco and alcohol, and lived experience of the people with tobacco and alcohol addiction and NCDs. The study was also limited by the cross-sectional study design of the study. More studies focusing on lived experience and focusing on a few key determinants may help to further illuminate the effects of tobacco and alcohol use and their role in accelerating NCDs epidemic. There were some methodological limitations as well. The participants of the workshops were mainly from the health sector. This may have weakened the feedback process where we expected feedback from multi-sector participants. However, this approach does present opportunity to further engage key stakeholders in transforming insights from current CLDs into collective action and learning (260).

Conclusion

Tobacco and alcohol use and addiction were key mediating factors linking broader social determinants (social, economic and political) to NCDs in Nepal, which was also depicted by the causal loop diagram. The research findings could be utilised in two

ways: to broaden one's understanding of the role of tobacco and alcohol use in the interaction of the social determinants of health; and to identify systemic actions for addressing such complex challenges from a systems perspective in Nepal and similar LMIC. This paper has not only shed light on addiction relating to the use of alcohol and tobacco products, but also in how addiction and availability are being influenced by socio-economic circumstances. Decline in community capital has been linked to both demand and supply of such products at community level, making it hard for any community-based initiative to control such products. From a gender perspective, tobacco and alcohol use were more concentrated among males whilst females were experiencing stress and violence due to addiction of such products among male members of the family. Socio-economic circumstances of families/communities not only pushed people into the habit of tobacco and alcohol use – for some, selling tobacco and alcohol products was also a means to improve socio-economic conditions. This reinforcing pattern was identified as a potential root cause of use of tobacco and alcohol. Health and social systems in Nepal were failing to tackle NCDs from social determinants of health perspective, including tackling tobacco and alcohol availability through policy and regulatory measures.

This paper has also indicated some potentially effective health system actions. These actions include prioritising primordial and primary prevention of NCDs, including increasing tax on tobacco and alcohol products and strengthening the monitoring of sales of such products as envisaged in the WHO Framework Convention on Tobacco Control and Tobacco Control Act and Alcohol Control Act of Nepal. The Ministry of Health, through a powerful central agency, could play a proactive role in informing and

advocating all sectors, including political leaders, for integrating health as a cross-cutting agenda and impacting on social and commercial determinants of NCDs.

Paper 3: The role of dietary practices and physical activity in the interaction of social determinants of non-communicable diseases in Nepal: a systemic analysis

Paper 3 describes the critical role of dietary practices and physical activity in the interaction of the social determinants of non-communicable diseases in Nepal and sheds light on experiences discussed in paper 1. Similar to paper 2, the dietary practices and physical activity-related themes have been discussed. Six key thematic areas relating to dietary practices and physical activity emerged, which facilitated the interactions of social determinants of NCDs.

This paper will be submitted to PLoS one journal.

Abstract

Background: The objective of this paper was to describe the critical role of prevailing dietary practices and physical activity in the interaction of the social determinants of non-communicable diseases (NCDs) in Nepal.

Method: The study was a qualitative study design guided by systemic intervention methodology. Qualitative data were collected through key informant interviews (n=63) and focus group discussions (n= 12), and case study-based thematic analysis was carried out. Qualitative system dynamics modelling was utilised to illustrate the connections between themes from the case study. The study also involved sense-making sessions with policy level and local stakeholders.

Results: Six key interacting themes and a causal loop diagram relating to dietary practices and physical activity emerged from the analysis. Limited awareness and misconception relating to diet and physical activity were contributing to increased risk of NCDs. The tradition of healthy and locally produced meals was gradually being displaced by junk foods and drinks and, to some extent, linked to junk food availability and declining agricultural activities in the case study areas. Gender influenced the physical activity pattern with females tending to be more physically inactive, particularly in urban areas. Importantly, socio-economic status was identified as the root cause of poor diet and physical inactivity. In addition, health and social systems were not effective in addressing the issues relating to diet and physical activity, which was aiding the rise of NCDs. The resulting causal loop diagram demonstrated how these themes were interacting in elevating the problem of NCDs.

Conclusion: This research has critically presented a combination of key social determinants influencing dietary practices and physical activity linked with rising NCDs in Nepal. While diet and physical activity-related knowledge and practices and environmental factors were limited, the broader determinants such as socio-economic status fuelled the migration and exposure towards an obesogenic environment. Further, the health system has potential to play an effective role in raising awareness, monitoring the markets for unethical marketing of junk food, and advocating for the preventative action with social determinants focus.

Background

Poor dietary habit and physical inactivity have been identified as key risk factors in increasing non-communicable diseases (NCDs) in LMIC (3, 261). It has been estimated that dietary and physical activity risks attribute to approximately 5.3 million premature deaths annually (262). In Nepal, the last Stepwise approach to surveillance (STEPS) survey has shown that about 99% of people did not consume sufficient fruits and vegetables but only 3% did not have adequate physical activity (179). However, the problem of physical inactivity was more pervasive in the urban and peri-urban areas with more than 5% of urban respondents categorised as physically inactive (179). A recent study showed that inadequate physical activity among adolescents was 85%, indicating the shift towards physical inactivity in Nepal (263).

Increasingly, there is evidence relating to socio-economic and environmental determinants influencing diet and physical activity, often collectively termed social determinants (264, 265). Global health agencies and experts have been pushing the agenda of NCDs prevention in both high and low-income nations through focusing on the social determinants of health (23-25, 27, 266). In 2008, the World Health Organization proposed the landmark *Social Determinants of Health Framework,* which highlighted the complex causal mechanism of complex health issues and suggested directions for actions (27). Since then, there has been increasing focus in understanding and taking action on the social determinants of complex health issues such as NCDs globally (267). However, LMIC are far behind in their understanding and actions on the social determinants of health compared to HIC (79-81, 267, 268). On a positive note, some Latin American and Caribbean countries are taking significant steps in addressing the social determinants of NCDs (269).

Global evidence has suggested that physical inactivity as well as junk food consumption is rapidly increasing due to social, environmental and economic influences (125, 264, 265). Rapid urbanisation and changing nature of work (sedentary nature and increasing mechanisation of physical work) are impacting physical activity and dietary patterns (264, 270). A Lancet review has suggested that physical inactivity is increasing among lower socio-economic groups (270). Moodie et. al. suggested that transnational companies are driving the junk food epidemic globally, resulting in increasing NCDs, even in LMIC (125). A study in Nepal has shown that urban population have an increased risk of chronic diseases due to ready access to junk food and limited avenues for physical activity (179). Further, limited policy and multi-sectoral action on healthy diet and optimal physical activity promotion have resulted in increase in NCDs and their risks (261, 271). However, there is limited evidence or analysis of the links between social determinants and NCDs mediated by diet and physical activity in Nepalese and LMIC context. This paper assesses the critical role of dietary practices and physical activity in the interaction of the social determinants of NCDs in Nepal.

Method

The study design was qualitative study based on systemic intervention (SI) methodology (figure 5) (162). SI adopts the critical systems thinking approach and stresses on using multiple methods from different disciplines to understand the complex problems. It is action-oriented and participatory in the approach it takes to address the problem. A combination of case study and system dynamics (causal loop diagram) methods, along with participatory sense-making workshops, were adopted within the research design to achieve the research objective in line with the methodology.

Study area and study participants

The study was conducted in Nepal from July until October 2016. Two districts (Bhaktapur and Morang) from Nepal were purposively selected as case districts. Within each case district, one municipality and two village development committees (VDC) were selected for community level data collection (i.e., Madhyapur Thimi Municipality, Dadhikot VDC and Sipadol VDC from Bhaktapur district and Biratnagar Municipality, and Tankisinwari VDC and Bahuni VDC from Morang district). Bhaktapur is a hilly district near the capital city of Nepal and has a sub-tropical cold and humid climate. Morang is a plain district located in the eastern part of Nepal and has a sub-tropical hot and humid climate. Key stakeholders from the policy level were also participants of the study, including those from Ministry of Health, Department of Health Services and other key central agencies. Participants were purposively selected based on their current engagement (or potential engagement) in NCDs prevention and health promotion in the case districts and at policy level in Nepal. They included members of *NCDs Multi-sectoral Action Plan Steering Committee*, academia, non-government organisations, District Health Officer, Local Development Officer, community-based organisations, local health workers and village leaders.

Data collection

Data collection involved semi-structured interviews and focus group discussion with study participants from the case districts. Policy level data were collected to supplement the information from case districts. We developed the semi-structured interview and focus group discussion tools, which were guided by the adapted social determinants of health framework (figure 3).

The sampling strategy for the study entailed identifying and participating individuals knowledgeable and experienced in the issue of interest i.e. NCDs prevention at case district and policy level in Nepal. The purpose of the purposive sampling was to capture the different perspectives and contexts on the NCDs prevention issue guided by the study framework (figure 3). Purposive sampling is often used in qualitative studies for identifying and interviewing potential information-rich subjects on a complex issue like NCDs (168).We adopted the "maximum variation" strategy to investigate any complex issue that emerged from across the sectors (168). Thirty-nine participants were interviewed from the two case study sites (Bhaktapur and Morang) and 24 participants from policy level. All of the interviews were conducted in Nepali. The time of interview ranged from 30 minutes to one hour.

Further, 12 focused group discussions (FGDs) were conducted within the selected municipalities and VDCs of the case districts. Each FGD included five to 10 community people experiencing and/or caring for family members with NCDs and their metabolic risks. The purpose of FGDs was to capture negotiated views on NCDs and risks as experienced by individuals, families and community members belonging to different socio-economic groups. Therefore, in each VDC/municipality, two FGDs were conducted with one group representing a socio-economically disadvantaged community and the other a more advantaged/mixed community. The FGDs were facilitated by the researcher with the help of local volunteers. The duration of FGDs ranged from 45 minutes to one hour.

Data management and analysis

We first transcribed the interviews and FGDs audio recordings in Nepali and then translated them into English for coding and thematic analysis. We utilised the *Framework Approach* to carry out the thematic analysis guided by the study framework (figure 3) (169). Themes were identified, grouped and coded by using both a deductive approach based on the study framework as well as more inductive approaches to allow for emergent themes. Case analysis helped in framing the qualitative and quantitative data for the local context and iterating on causal linkages of various social determinants. We then developed a system map or Causal Loop Diagram (CLD) to illustrate the causal linkage and mechanism of the social determinants of NCDs indicated by thematic analysis. Causal loop diagramming is a system dynamics technique to build a system map of a problem of interest that illustrates the causal mechanism through feedback structures that are loopy in nature. The convention/analytical strategy to develop the CLD in this research has been adapted mainly from a key system science resource, namely *Business Dynamics* (152). CLD consists of two types of feedback loops: balancing and reinforcing loops, and these loops have variables connected by uni-directional arrows with either positive or negative signs on them. A positive sign indicates that if the independent variable increases or decreases, the dependent variable also increases or decreases in the same direction. A negative sign indicates the exact opposite meaning i.e. if independent variable increases, then the dependent variable decreases and vice versa. The balancing loop is a goal-seeking loop, which is indicated by "B" within CLD and indicates the stabilising feature of the loop. In general, causal loops with an intervention are of a balancing nature that tried to mitigate the problem. On the other hand, reinforcing loops (indicated by "R" within CLD) depict a mechanism that produces a result that influences more of the same action, thus resulting

in either growth or decline. An example of reinforcing loop can be the vicious cycle of poverty and ill health.

Dedoose (Socio-cultural Research Consultants) and *MS Excel 2016 (Microsoft)* (171) were used to manage the qualitative data (170) and *Vensim (Ventana Systems Inc.)* was used to build CLD (172).

Stakeholder Validation

Stakeholder validation was conducted through organising three sense-making workshops, two at respective case districts and one at national level during January/February, 2018. The workshops helped to further enrich the analysis through the feedback and suggestions from the stakeholders. These workshops, indeed, became opportunities to sensitise the stakeholders about the impending epidemic in Nepal. The workshops proved useful in reaching the purpose of this research and the methodological stance of systemic intervention methodology.

Ethical Consideration

Formal ethical approvals were taken from the Massey University Human Ethics Committee and Nepal Health Research Council Ethics Committee (Nepal) respectively. All participants, and in particular disadvantaged and less literate groups, were clearly informed about the purpose of the study. All participants were provided with an information sheet, and a voluntary written consent was obtained from all participants of semi-structured interviews and focus group discussions.

Results

Six key interacting thematic areas relating to dietary practices and physical activity emerged, which were utilised to develop a causal loop diagram and demonstrate dynamic complexity.

Thematic area 1: Awareness and misconception relating to diet and physical activity contributing to increased risk

Many participants associated the link of unhealthy diet and limited physical activity with NCDs based on their personal experience. According to them, current food habits among most Nepalese were not balanced, which was leading to the problem of NCDs.

> *"Nepalese food is taken three times a day. And there is rice every time, even in the snack. That is why now, 2 out of 4 people of a family have high sugar level." (Rural Morang FGD Participant; ID: 69)*

> *"People do consume salt relatively in high amount in villages and they prefer spicy food." (ID: 64; Rural Morang; FCHV)*

The participants stressed that the knowledge and practice relating to balanced diet and physical activity were low, especially among disadvantaged groups.

> *"The maximum number of patients in OPD belongs to Magar community and Rishidev community. They don't eat balanced diet; Magar eat more fatty food like pork meats." (ID: 61; Rural Morang; Health Worker)*

Participants shared that even people having sound knowledge about balanced diet were complacent about their health. In the case districts, people often consumed without considering their daily calorie requirement and did not take up physical activity until they were affected with some physical problem.

> *"Being a Nepalese, I never compromise in food." (ID: 71; Urban Bhaktapur; FGD Participant)*

Further, there was much misinformation and many unhealthy practices relating to diet and physical activity, which was exposing people to increased risk of NCDs.

> *"We eat enough food (at night). Since that has to withstand us up to 10 am in the morning." (ID: 69; Rural Morang; FGD Participant)*

> *"For diabetes, doctor prohibits many foods. If we stopped eating those prohibited foods by doctor, then we would have died 7–8 years earlier. We have organs which need these foods." (ID: 76; Rural Bhaktapur; FGD Participant)*

Thematic area 2: Neglect of traditional practices of healthy eating and physical activity

One key observation highlighted by participants from the case districts was that the traditional practice of healthy eating was being gradually displaced by a Westernised practice of eating, which is unhealthy for the Nepalese context. A FGD participant from rural Bhaktapur lamented:

> *"We used to have "Dhido" in the morning and in the evening. We used to run home from school during lunchtime, have the lunch and return back to school.*

But these days vehicles come to pick up and drop our children and there is no time to prepare lunch for the children. So junk foods are easy." (ID: 76)

A policy level key informant explained that overwhelming availability and appeal of junk foods were affecting local dietary practices.

"In case of food habit, our raw food/fruits habits have been changed to junk food based diet. Junk food are readily available, easy to cook and do not need much effort. There is an increase in the use of junk food from a very early age." (ID: 3; Policy Stakeholder; Health)

Many participants noted a shift in dietary pattern from low meat diet to high meat diet along with increased sales of meat items in communities of the case district.

"In the past, there should be occasion like Dashain, and other festivals for consuming meat. But now meat is consumed in every house every day and beyond limit." (ID: 23; Policy Stakeholder; Health)

Some participants stressed that the Nepalese culture and traditions have potential to promote physical activity and healthy diet but they continue to be ignored. Offering prayers to different temples in a single walk (Newari culture), yoga and meditation (Hindu culture), "Namaz prayer" (ritual Muslim prayer, which also involves different body movements) were stressed by participants as practices that have physical activity significance.

"In context of our geographically and culturally diverse country, we have our own traditions of practicing yoga, meditations, bipasyana etc. but these aren't practiced in our daily schedule." (ID: 12; Policy Stakeholder; Health)

Participants also reported the decline in physical activities like walking due to increasing use of motor vehicles in the communities.

> *"People who used to walk now use bicycle and motorbike now and that makes easy for them. Because of that too, it has been decreased now." (ID: 66; Urban Morang; FGD Participant)*

A case study district stakeholder elaborated that people often resort to physical activity practice, including yoga and morning walks, after they start suffering from diseases or metabolic risk.

> *"If we ask 100 people who come to Yoga if they do not have any such disease or conditions, only few hands would raise up." (ID: 30; Bhaktapur District Stakeholder; Non-health)*

Theme 3: Health and other sector issues in initiating the multi-sectoral action to improve dietary practice and physical activity

Unregulated marketing and framing of junk food were creating an obesogenic environment in the case studies. In particular, a significant share of the diet of adults and children comprised of junk/fast food due to which other traditional dietary practices have been affected.

> *"Nowadays people are eating lot of fast food. Ten years earlier people used to have home beaten rice and beans; corn (pop-corn) and would have a balance diet. But now people do not eat at home; they eat outside and mostly junk food. Balanced diet knowledge decreases as family education or socio-econ status deceases affecting the vulnerable groups." (ID: 35; Rural Bhaktapur; Health Worker)*

"Second one is food habit where major issue is aggressive advertisement of junk foods. What is happening is, gradually we are leaving our Indigenous food habits and shifting towards the trend of consumption of junk foods may be as a fashion or may be as a status symbol." (ID: 9; Policy Stakeholder; Non-health)

In addition, participants stressed that increased motorisation and lack of systemic infrastructure were leading to limited physical activity in the case studies. There has been a rapid development in road infrastructure and motorisation of public and private transport systems. However, due to lack of awareness regarding active travel and luxury-seeking behaviour, this has been contributing to physical inactiveness to some extent.

"These days, vehicles are available right in our doorsteps. Now instead of walking to the place that takes 30 minutes, we wait an hour for the vehicles to take us there." (ID: 65; Urban Morang; FGD Participants)

Urban areas of Nepal have poor urban planning, leading to limited green and open spaces for promoting physical activity among the residents. Though there are policies and regulations relating to urban and housing design in place, residents simply ignore them and the regulations are not strongly implemented enough to have any meaningful impact. This is leading to cumulative effect of limited space as explained by a policy stakeholder:

"What has happened is lack of open space has become an increasing problem because of population growth and exposure to open space is diminishing /decreasing. This leads to decrease in people's habit of roaming, walking, exercise and lack of good/high oxygen concentration. This trend is slowly fading

away even in rural areas and condition has worsened in urban areas." (ID: 11; Policy Stakeholder; Health)

Some participants linked limited physical activity with system ignorance and limited promotion of yoga and traditional physical activity. Often the system was not focusing on instilling habits of physical activities among the young people.

"We ourselves are responsible for the current state of yoga. We couldn't direct the young generations to a correct track." (ID: 52; District Stakeholder Morang; Non-health)

Key policy stakeholders shared how the current lack of concrete structure and leadership relating to NCDs prevention is creating a delay in coordinated NCDs action.

"There are budget for NCDs but are scattered in various places. That has to be managed through certain centre in an effective way." (Policy Stakeholder; ID: 12; Non-health)

"I have felt the programmes within Ministry of Health a bit uncoordinated. This is the state of coordination within Ministry of Health. But, I must accept that everyone is working towards bettering the coordination at least within Ministry of Health." (ID: 13; Policy Stakeholder; Health)

Health policies and structure often considered NCDs as a curative care agenda rather than a multi-sectoral agenda focusing on developing healthy dietary behaviour and active living.

"Our health system is resisting to adapt to addressing NCDs issues from health promotion and prevention aspect." (ID: 18; Policy Stakeholder; Health)

The district health system and below are caught up in inefficiency and ineffectiveness and have limited NCDs prevention-related activities in the study districts. Health workers lacked training in NCDs prevention, and the office had limited resources at their disposal. A district stakeholder shared how the current health system was more focused on curative care than preventative action.

"Our [Primary Health Care] network is very good. But, it is less focus on primordial compared to curative. Our system can do more primordial prevention." (ID; 25; Bhaktapur District Stakeholder; Health)

Thematic area 4: Declining agricultural activities affecting local food system and physical activity level

Agriculture, one of the mainstays of Nepalese economy, was declining rapidly according to participants from case districts. One key reason reported was increase in commercial allocation of agricultural land for housing due to rapid urbanisation. This was resulting in disruption to local food systems due to decline in agriculture activities.

"Agricultural land are plotted and then converted to real estate business." (ID: 44; Urban Bhaktapur; Social Worker)

Another key reason expressed by participants for decline in agriculture was increasing focus on sedentary jobs in urban areas and abroad. The reasons for this were agriculture being too hard to do and often being associated with low status jobs.

"People are doing less physical activity and exercise than before. Importantly, agricultural activity is on a decline, everyone is now buying and eating food items in rural areas. People do not engage in hard agricultural practices as they used to do. People now eat too much of unhealthy products." (ID: 55; Rural Morang; Health Facility Management Committee member)

Thematic area 5: Gendered-related norms and cultural shifts affecting physical activity

There were some revelations about the influence of gender on the physical activity practice. Participants shared that in urban areas, females tended to be physically inactive and overweight/obese.

"In urban and semi urban areas obesity is seen more in married female." (ID: 5; Policy level)

However, there were some positive actions being initiated within urban communities where more females compared to male were engaged in yoga.

"You may see that many females come to the yoga and are often married. Not many males come; probably due to complacency and laziness." (ID: 44; Urban Bhaktapur; Social Worker)

Similarly, participants shared that more and more families of foreign employed males were migrating to urban centres for a better life. As a result, females were detached from their regular agricultural works in the rural context and confined to limited space rented houses, which significantly reduced their physical activity.

"If we talk about those families whose members are working abroad, their families now have started living in the market areas and depend upon market for

every necessities including the vegetables which once they themselves used to grow." (ID: 7; Policy Stakeholder; Health)

In rural context, women who were mainly engaged in agriculture and animal rearing have declined rapidly. Here are some of the expressions from the FGD participants, which could be linked to a rise in overweight and obesity issues among females.

"It's been many years since I last reared any animals." (ID: 75; Rural Bhaktapur; Female FGD Participant)

"In our time we used to run to the field soon after having the meal. We used to cultivate different crops and plants like maize, mustard and many more. We used to grow mustard here like in Chitwan but now there are only bushes and grasses in those lands." (ID: 76; Rural Bhaktapur; Female FGD Participant)

Thematic area 6: Socio-economic status as the root cause of poor diet and physical inactivity

The participants from the case districts pointed out that many families from rural areas were migrating to urban areas and foreign countries.

"Low income families opt for Middle East for opportunities; high income families for sending to foreign for education." (ID: 44; Urban Bhaktapur; Social Worker)

"Everyday around 800–1000 people are flying abroad." (ID: 9; Policy Stakeholder; Non-health)

A policy stakeholder has also noted that this migratory movement was due to socio-economic situation of the country, which was not only affecting the agriculture sector in rural areas but also exposing a significant number of vulnerable populations to an obesogenic environment.

> *"Urbanisation is rapidly increasing. Employment opportunities are more in foreign lands. At least one member of a household is earning in foreign land. Now the proportion of population involved in agriculture has decreased in recent times. People's profession has changed. Along with the change in profession, people's lifestyle has also changed." (Policy Stakeholder; ID: 6; Health)*

Further, the migratory phenomena have increased the economic capacity of the families, resulting in increased access to junk food according to a case district stakeholder.

> *"Our economic status has raised drastically may be because of foreign employment or may be due to rise in the salary and wages or may be because of various other business or land broker, people's income has increased." (Morang District Stakeholder; ID: 47; Non-health)*

However, one of the key stakeholders explained that regardless of economic status, poor dietary practice and physical inactivity were affecting everyone from rich to poor.

> *"There are certain things about poor population as they have unhealthy diet but they are involved in lots of physical activity during digging, working; the disease differs between the poor and the rich. Physical activity is the good aspect among the poor but there are many other factors that are negative like unhealthy diet (consume more fast foods), inaccessibility of treatment facility and many stress*

factors among the poor people results in their diseased condition. Beside that behaviour of smoking and alcohol consumption among poor is another cause of disease." (Policy Stakeholder; ID: 4; Health)

CLD of major sub-systems depicting the interaction of the social determinants of poor diet and physical inactivity and NCDs

The CLDs below have been derived from the thematic analysis and show the dynamic interaction of the key variables discussed above contributing to the problem of NCDs in Nepal. As indicated, the development of the CLDs was an iterative process and was conducted simultaneously with thematic analysis. The CLDs depicts three prominent feedback mechanisms or sub-systems displaying the interactions of the social determinants of NCDs: prevention delay, demand-supply and socio-economic influence.

Prevention Delay Sub-system: In figure 13, the prevention delay subsystem (indicated by black arrow) consists of delayed balancing loops, which highlight themes that indicate limited and delayed action by the health system towards addressing poor diet and physical inactivity-related practices as indicated in the results. Awareness-raising campaigns and multi-sectoral coordination for promoting sustainable food systems and physical activity-friendly environments were lacking for prevention of NCDs. The health system was possibly guided by the mental model that poor diet and physical inactivity were more due to individual behaviour, hence the interventions in LMIC were limited to campaigns and medical services provision. The CLD highlighted the themes indicating that multi-sectoral coordination for sustainable food systems and improving physical infrastructure were continually neglected by the overall health and social system. The themes also indicated that junk food companies are using various tactics to

promote their products as a healthier option. The same sub-system hints at the curative orientation of the health system (i.e. the increasing chronic diseases problem in turn put pressure on the government to provide curative care services, leaving limited resources for preventative actions, including multi-sectoral coordination).

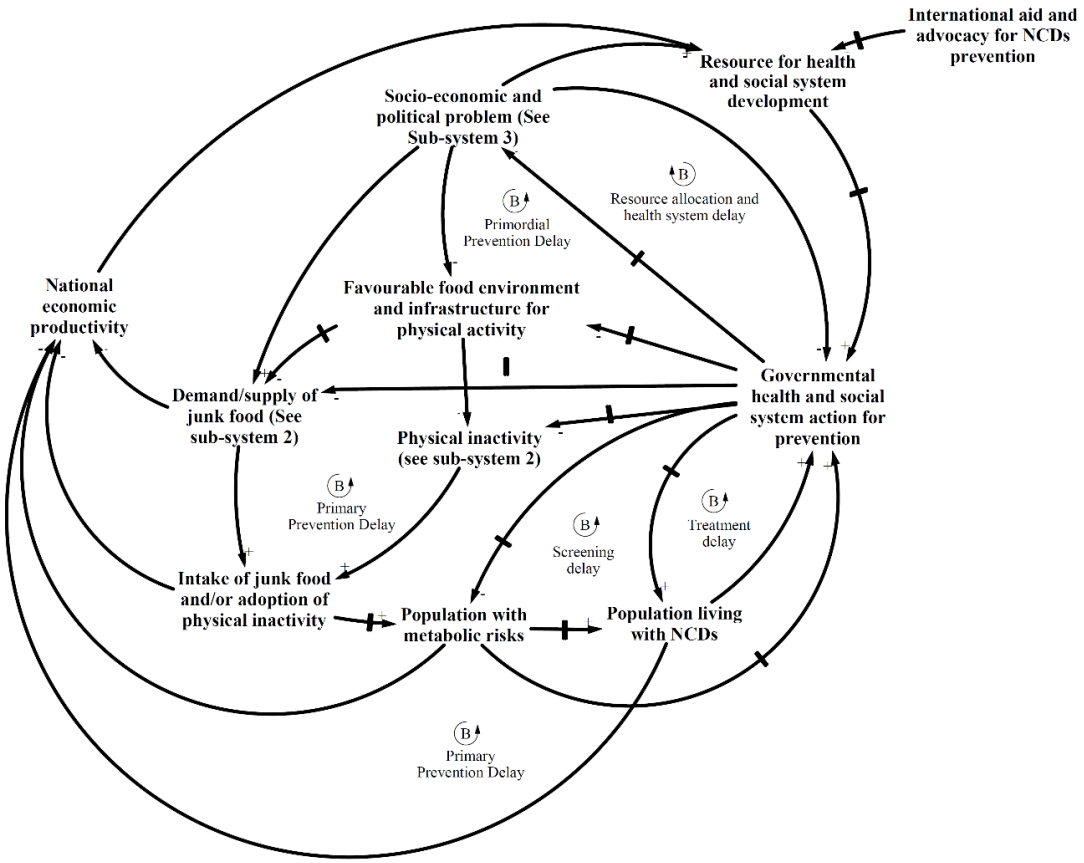


Figure 13. Prevention delay sub-system showing the interaction of governmental response to promote healthy diet and physical activity, other sub-systems and NCDs

Demand-supply sub-system: Sub-system two (figure 14) highlights how individuals and communities were being framed for consuming junk food and drinks due to limited policy and programmatic interventions relating to junk food/drink. The demand-supply sub-system mainly comprised of reinforcing loops and showed that junk food

availability was resulting in increased consumption and affecting local food systems as well as social practices in the case district of Nepal. The extensive marketing of such products as healthy, easy to prepare, cost-effective, family food, etc. have driven the consumption of junk food. The junk food companies are possibly utilising their economic strength to influence both government and public through policy influences and marketing as indicated by study participants.

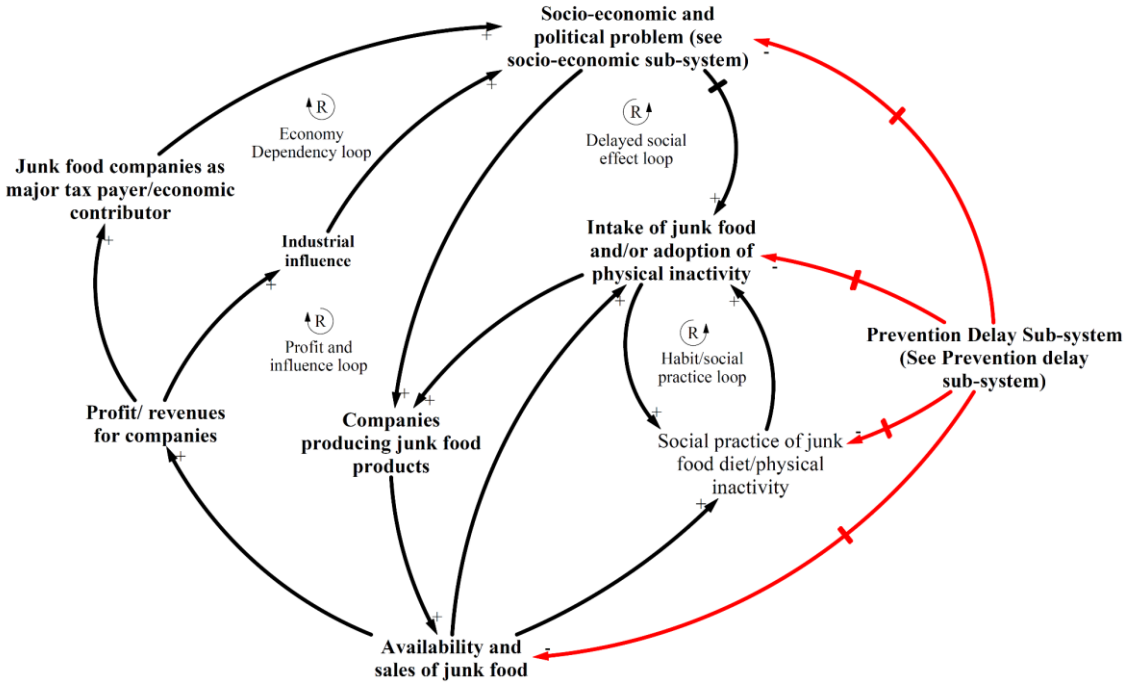


Figure 14. Demand-supply sub-system showing the interaction of availability and sales of junk food, other sub-systems and NCDs

Sub-system three (figure 15) is the socio-economic influence sub-system that can be conceptualised to distally drive the other two sub-systems towards increasing the burden of NCDs as per the thematic analysis. The socio-economic sub-system shows the dynamic complexity about how junk foods, physical inactivity and social and economic influences were interacting, which was giving rise to NCDs problems. Further, migration of economically active groups to city areas and foreign countries, as

expressed by study participants, can be linked to decline in the agricultural system (which was expressed by study participants), which was not only pushing the rural agriculture system to the verge of collapse but also exposing rural people to junk food and sedentary lifestyles. The decline in agriculture can also be assumed to be affecting national economy overall.

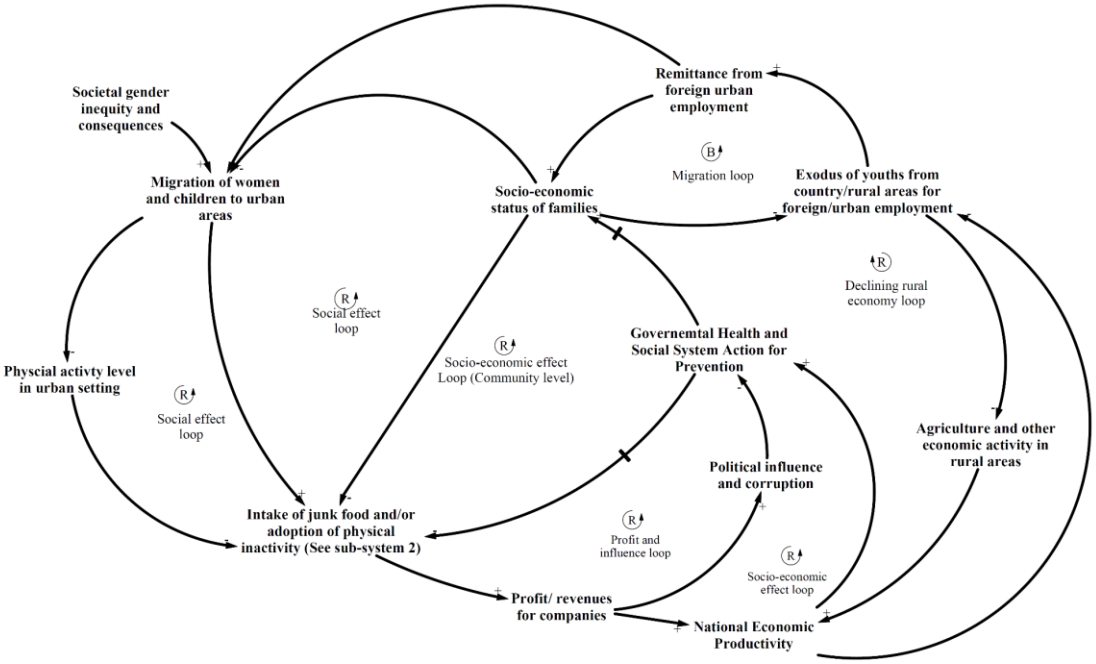


Figure 15. Socio-economic influence sub-system showing the interaction of socio-economic status, other sub-systems for dietary and physical activity practices and NCDs

Discussion:

The causal mechanism of influence of the diet and physical activity on NCDs was complex and is discussed here in the light of existing evidence and from systems perspective. Specifically, we utilise system archetypes (figure 16), a simpler version of CLDs, to present the mechanism in a simpler version and in a way that generates insights for health system action (259).

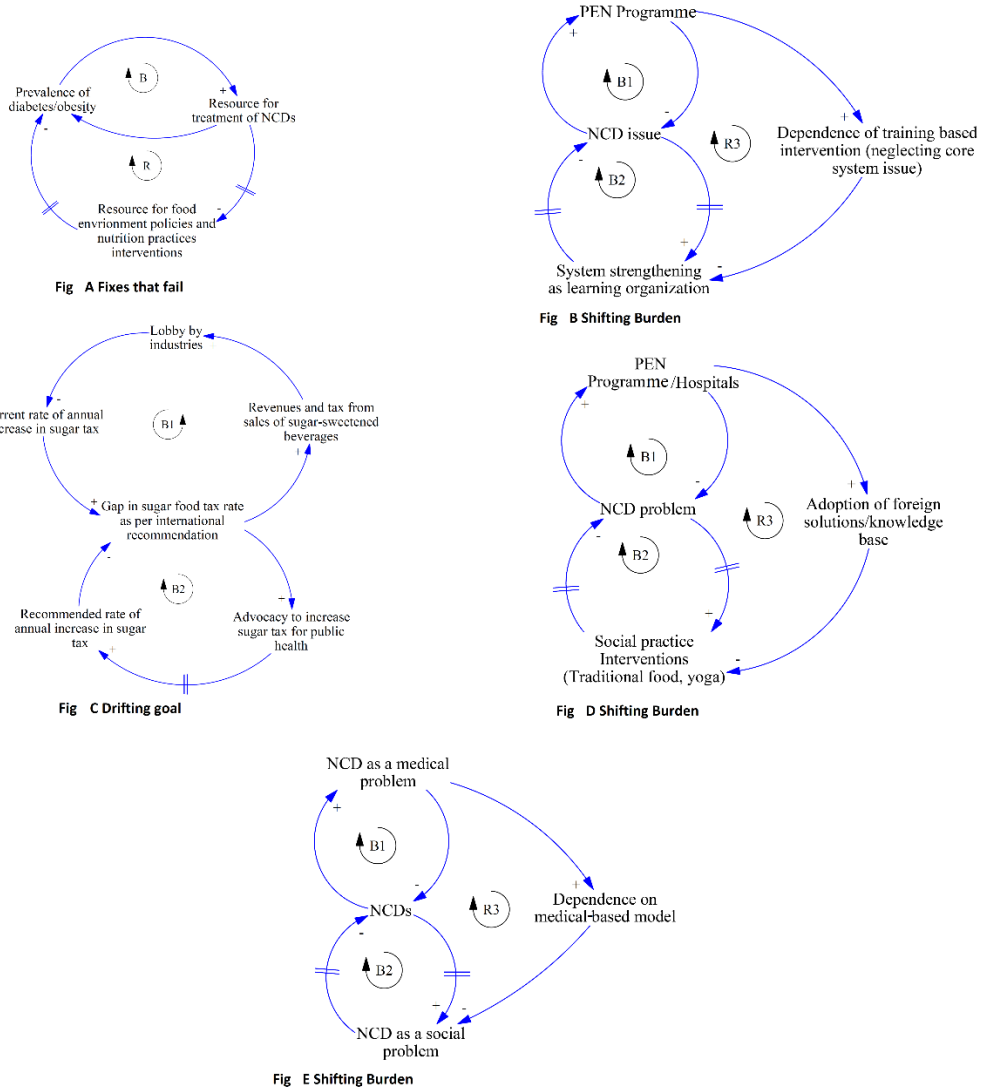


Figure 16. System archetypes showing different mechanisms of influence of dietary and physical activity practices on NCDs

Promotion of healthy dietary behaviour and physical activity

In this study, sub-system, one of the CLDs, indicated that the health system was not functioning effectively to promote healthy behaviours relating to diet and physical activity. This resonates with the *Fixes that Fail* system archetype (figure 16 A).

The health system is yet to prioritise the prevention of NCDs and their behavioural risks in many LMIC like Nepal (272-275). In Nepal, evidence indicates that NCDs have been considered as a curative service agenda with increasing budgetary provisions in hospitals, patient care and development of clinical human resources rather than prevention (77). Further, in many LMIC, national strategies for improving diet and physical activity exist (127-130) but most strategies are not effectively implemented due to limited resources and system inefficiency (13, 236). In particular, LMIC are often lagging behind in terms of formulating and implementing legislations and programmes relating to control of junk food as well as developing physical activity-friendly infrastructures and systems (125, 276), similar to the findings in this study. While HIC are gradually addressing the junk food epidemic through policy measures, LMIC do not have any mechanism in place to control the junk food epidemic. The junk food companies are being increasingly compared to tobacco/alcohol companies due to their marketing strategies that target vulnerable children and population groups and their role in affecting the local food systems and ultimately health (125). Further, poor systematic infrastructure-related policy action has been contributing to poor physical activity around the world (276, 277).

Health system functioning in Nepal affecting prevention action in general

In addition, sub-system one indicated that disease prevention and health promotion efforts in Nepal have been offset by weaker health system functions. The system function becomes inefficient and complex problems like NCDs continue to persist as the focus is on easily implementable solutions that only address symptoms but not the actual problem. This can be captured by the *Shifting Burden* archetype (figure 16 B). Many LMIC face similar health system challenges such as poor governance and management, resulting in inefficiency and ineffectiveness (240-242, 278). The health system continues to be ineffective and inefficient due to top-down approach, and leadership and management issues. Public health actions are often short-sighted and do not collaborate effectively with other sectors. In a way, public health actions in LMIC shift towards short-term actions, which are easier to execute but the least effective. Strong leadership, appropriate system structure and political commitment could play a significant role in strengthening the health system and supporting prevention initiatives in LMIC like Nepal (2, 13). This also provides more time and resources to mature the impact of prevention policies in combating complex problems like NCDs and their behavioural risks as prevention often needs multi-sectoral coordination (279, 280).

Junk food access and marketing influencing consumption of junk foods

Sub-system two of the CLD showed an increased access to highly processed food by everyone, especially young people. Evidence suggests that the junk food habit is very pervasive among children and adults in both urban and rural areas of South Asia region (281-284). Further, a key mechanism that was prominent in the findings was the deskilling of the traditional food preparation due to wider availability of the junk food and fast food. Evidence from around the world has also confirmed that traditional-based

diets are gradually being replaced by junk food habit (285-288). A review has highlighted how the local food systems were being shaped more by profit motives of the companies than by optimal nutrition (289). In addition, migration of male youths, especially from rural areas, was driving the migration of families to urban areas, which is suddenly exposing families to an obesogenic environment.

Marketing of junk food is another key reason for the increasing access of the junk food as shown by different types of evidence (290) and highlighted by sub-system two. Often, the junk food companies would associate their products with some social services or claim their products to be nutritious and can be enjoyed by an entire family through quality advertisements (185). Such practices of popularising and misleading wider masses have been well documented in developed and LMIC (185, 291, 292), which has been very pervasive in the context of Nepal. Similar to this study, a report identified the price factor, easy availability and lack of government control were some of the factors that were leading to families providing children with junk food (185).

Enforcement agencies have limited ability to control junk food due to lack of regulations and positive framing of junk food by companies producing junk food. In fact, fast food and sugar-sweetened beverages issues have not received much attention in public health policies and action in LMIC (125), which has also been reflected in the themes of this paper. Further, the effects of junk foods effects on sustainable food systems have not been explored extensively. HIC with ample evidence of junk food effects and popular support against them are still facing stiff challenges in curbing the obesity epidemic created by big food companies (293, 294). The labelling of products is still a contested issue in Australia and New Zealand (295). A Lancet review suggested

that tactics of food companies influencing national policies were similar to that of tobacco companies (125). The *Drifting Goal* system archetype depicts the influence of food industries in delaying public health regulations such as sugar tax (figure 16 C).

State of physical activity, including traditional exercises

As noted in the themes and indicated in the CLD (interaction between all three subsystems), physical activity was on a decline in both urban and rural areas. A study in India showed that physical activity was gradually decreasing in rural India as well due to increasing urban influences, including adopting urban lifestyle in rural settings, motor vehicle access and mechanisation of agricultural activities in rural areas (182). Research in rural India and Bangladesh show a similar increasing phenomenon of physical inactivity in rural areas (296-298). This study showed a pattern of adults being physically inactive and adopting energy-dense food during adulthood. A similar pattern has been observed elsewhere in LMIC contributing to NCDs (26, 299, 300). People only resorted to healthy diet and exercise after being affected with metabolic risk, a tendency that can be explained by behavioural and psychological theories (301, 302). Some evidence has even suggested people do not readily change their lifestyle in the South Asia region even after being affected with NCDs risk (303).

The study findings suggested that traditional exercises were being ignored, which have potential to keep the general population healthy, based on cultural values and beliefs. The Vedic culture of Nepal (relating to Hindu religion) is rich in such exercise practices, particularly in yoga and meditations. Yoga is becoming increasingly popular in the Western countries due to its benefits (304) but continues to be neglected in Nepal. This can be explained by *Shifting the Burden* archetype (figure 16 D) where the health

system has not realised the most effective and preventive measures are based on local socio-cultural practices.

Agriculture practice and effect on local food systems

The study findings and the CLD (sub-systems two and three) also indicated that the agriculture practice has been significantly reduced with limited workforce engaged in agriculture in rural areas. This has impacted indirectly on the physical activity practice of rural residents as noted in the findings. By shifting the burden archetype perspective, the health system is failing to collaborate with other sectors to act on the social determinants of health, which are the root causes of complex health issues like NCDs.

LMIC like Nepal have been experiencing a rapid migration of economically active youths to urban centres within countries and overseas, creating a shortage of workforces for the agriculture sector. It is exposing people to sedentary lifestyles while decline in agricultural activities is also affecting the local food systems. A review has suggested that locally grown fresh foods were being replaced by imported vegetables and international junk food and supplies, which are cheaper (305). As a result, the share of agriculture in the gross domestic product has been rapidly decreasing despite a significant (but declining) population still being engaged in agriculture and availability of improved technologies for the agriculture sector (306).

Gender determinants of diet and physical activity

This study discussed the increasing issue of obesity among women, especially in urban areas. From shifting the burden archetype perspective, the narrow medical model

approach to NCDs is diverting the focus on the gender aspects that need collaboration and co-designing interventions with related sectors.

A review paper from Nepal reported similar findings to this study that women who are economically well-off are more exposed to the obesogenic environment (283). Such gender-based obesity differentials have been observed in both Nepal and Bangladesh (307). Urban females' lack of exercise could be understood by the fact that they remain mostly inactive due to confinement to household duties and child rearing, an outcome of Nepalese patriarchal social construct. A sense of the low power of females can be interpreted by limited access, time and autonomy for females to care for their health and engage in active lifestyles. Similar findings have been reported elsewhere (308). However, more critical observation is needed to understand the level of autonomy and access to services of those women.

Socio-economic status effect on dietary practice and physical activity

This study showed that socio-economic status was influencing the diet and physical activity practices in multiple and complex ways, particularly among middle- and low-income group from the case districts.

In rural areas, there was limited awareness about diet and physical activity. However, a relatively higher level of physical activity in rural areas could be attributed to agriculture and farming practices, while in urban areas, despite awareness, practice of balanced diet and physical activity was lacking. Available evidence also indicated this complex relationship (270, 309). Some evidence showed that higher income groups were physically inactive while in some context, lower income groups had poor physical

activity (310, 311). A Lancet article noted this complexity and indicated that there may be a social patterning, which was shifting in the LMIC (270). Such a shift of social patterning needs to be further researched. In this study, health was secondary to people experiencing economic hardship. More and more people are migrating to urban areas due to economic hardship and unequal development, which is exposing people to urban influences of junk food diet and limited physical activity. A study in the US has shown that low-income households have a fatalistic attitude towards their health, possibly due to socio-economic circumstances and lack of ability to control their lives (312).

Further, the possible interaction of the socio-economic sub-system with the prevention delay sub-system shown in the CLDs is yet to be appreciated by the health system, thus resulting in limited action on social determinants of NCDs. This medical model approach of the health system closely resonates with *Shifting the Burden* archetype (figure 16 E). This again is an important research area for the low-income countries, especially with the current increasing focus on comprehensive approaches to health promotion.

This CLD model and its archetypes could provide critical insights in addressing NCDs through promoting healthy diet and physical activity based on the systems thinking approach. This model could be a starting point for action and further improvement through integrating new evidence as we progress. Health and social systems are in a good position to advocate and accelerate actions on the social determinants of NCDs in relation to diet and physical activity.

Limitations of the study

The research comprised of some key limitations. The broader scope of the study framework, which was based on the WHO framework, may have weakened the study design to some extent. The research was only able to partially illustrate the dynamic interaction of NCDs. However, this has been the strength of the system thinking approach, which can be improved with further new evidence and research. One key area that the data could not answer was the impact of financial burden on families due to associated NCDs. Cross-sectional study design has also affected the research process. Additional qualitative and quantitative studies are needed to understand the dynamics interactions of the social determinants of NCDs that were facilitated by poor diet and physical inactivity. Ensuring participation of local stakeholders from multiple sectors during the sense-making workshops was a key methodological challenge.

Conclusion

This paper has presented a combination of key social determinants influencing dietary practices and physical activity linked with rising NCDs in Nepal. While diet and physical activity-related knowledge and practices as well as environmental factors were poor, the broader determinants such as socio-economic status accelerated the migration to urban areas and exposure of population (in particular, female and children) to an obesogenic environment. In particular, traditional dietary and physical activity practices were being displaced negatively affecting one's health. Decline in agricultural activities was affecting local food systems and physical activity level in rural areas. Further, health system actions were delayed in terms of regulating junk food sales and coordinating with other sector for improving physical activity. The health system could play a key role in raising awareness, monitoring the markets for unethical marketing of

junk food, advocating for healthier options that could be grown locally and coordinating with other sectors for creating infrastructure that promotes physical activity. MoH could advocate and show evidence of the need for such preventative action through the creation of a powerful national agency to facilitate intersectoral collaboration and achieve SDH focus.

Paper 4: Health and social system challenges to tackle social determinants of NCDs in Nepal: a systemic analysis

The objective of this paper was to examine the health and social system challenges in addressing the NCDs issues in Nepal from a systems thinking perspective, which has been reflected in all the previous papers. Paper 4 has presented further in-depth understanding of the health system issues. Three key thematic areas emerged from the study relating to the health and social system's lack of organisation, leadership and resources to tackle NCDs from the social determinants perspective of health.

This paper will be reformatted and submitted to Global Health: Science and Practice journal.

Abstract

Objective: To examine the health system challenges addressing NCDs in Nepal from the systems thinking perspective.

Method: This qualitative study involved collection of data through key informant interviews (n=63) and focus group discussions (n=12) from two case districts and policy level in Nepal. Case study-based thematic analysis was performed by utilising the coded qualitative data and Causal loop diagram was developed based on thematic analysis. The study also involved sense-making workshops with policy level and local stakeholders for suggestions on the preliminary results.

Results: Three key interacting themes emerged relating to health system challenges in preventing NCDs and their risk factors. The curative orientation of the health system was leading to limited resources and lack of system structure for prevention of NCDs. The district and local health systems had limited capacity in the case districts to provide NCDs-related prevention and treatment services. The limited role of the health system in impacting overall equity and access to health services emerged as a major cross-cutting theme.

Conclusion: NCDs are considered as curative service agenda by the Nepalese health system with limited efforts and resources being mobilised to systematically and equitably address the social determinants of health and, specifically, NCDs. The Ministry of Health should establish a national agency, with real power, for NCDs prevention while strengthening and reorienting the existing primary health care system.

Through the national agency, the health system could initiate a multisector coordination mechanism for addressing social determinants of NCDs.

Background

Non-communicable diseases (NCDs) are responsible for 41 million deaths each year, which is equivalent to 71% of all deaths globally (313). NCDs are a complex problem that poses challenges to effective health system action (314, 315). Many countries are still lagging behind in their understanding of the complexity of the issue and therefore which appropriate actions to take to curb the prevalence of NCDs (47, 143, 316). NCDs disproportionately affect the poor and vulnerable communities contributing to health inequity (316, 317). Despite world leaders having proposed, as early as 2011, the prevention of NCDs and their social determinants as a key global strategy to curb the burden and impact of NCDs (23, 266), there has been little tangible progress since then (318). The role of the 'health system' has been signified as one of the key determinants of health within the *Social Determinants of Health (SDH) Framework* (27). The framework illustrates how health system design, operation and financing can have significant impact in tackling public health issues like NCDs. Successfully tackling NCDs has been considered as a litmus test for health system capacity and effectiveness in LMIC (319).

The health system of many LMIC has been set up to deal with communicable diseases and maternal child health (MCH) issues because most deaths and illnesses has been caused by those issues (13, 17, 72, 320). Training of human resources and organisation of health services has been done accordingly. Further, global funding priority towards communicable diseases and MCH has often been cited as a key reason for limited international aid for NCDs (143). As a result, there have been only piecemeal policy and programmatic efforts for preventing NCDs in LMIC like Nepal (13, 321). Poor management, limited intersectoral coordination and top-down functioning of the health

system are some of the chronic issues that have bearing on the ability of the health system in LMIC, including Nepal, to address NCDs (13, 322).

There has been growing emphasis by public health experts and scholars in adopting systems science approaches to both understand complex issues like NCDs and improve the resilience and efficiency of the health system of LMIC to better tackle such complex issues (148, 150-152). Systems-informed approaches have potential to provide a rich understanding of NCDs issues, including understanding complex causal mechanism, strengthening collaboration, providing continuous feedback and learning to improve the intervention by health systems. Limited evidence and insights on social determinants of NCDs have been delaying the systemic prevention of NCDs and their risks by health systems in LMIC like Nepal. Further, considering health systems as a social determinant of NCDs from a systems perspective has not yet been explored in a low-income country context. The objective of this study was therefore to examine, from a systems perspective, the health system challenges for effectively addressing the growing burden of NCDs in Nepal.

Method

The overall study design was qualitative and involved multiple methods (case-study and causal loop diagram (CLD)) and sense-making workshops with local stakeholders (figure 5). The methodology was informed by a systemic intervention approach (161). The study was based in Nepal. The study tools were informed by the adapted *SDH Framework* (figure 3) and aimed to capture the experience and perspectives of the participants on the health and social system performance and challenges in relation to NCDs prevention.

The study involved data collection at two geographic districts (Bhaktapur and Morang) and policy level. In each of the case study areas, the first author conducted key informant interviews with purposively selected stakeholders (n=39), including Female Community Health Volunteers (FCHV), Health Workers, Village and Municipality Council Chiefs, District Health Officers, District Education Officers, District Police Chiefs and non-government organisation representatives. The first author conducted focus group discussions (n=12) in 12 purposively selected communities (six in advantaged communities and six in disadvantaged communities) within each case district. At the policy level, key informant interviews were conducted with policy stakeholders (n=24) and the data integrated with the case studies. The interviews and focus group recordings were first transcribed in Nepali and translated into English for coding and thematic analysis. The adapted framework guided the thematic analysis in coding, charting and interpreting the data. The identified dynamic and causal mechanisms were then illustrated using causal loop diagram (CLD). Causal loop diagram is a system dynamics tool that illustrates the causal mechanism of a complex issue like NCDs through loops showing causal influence between variables and interaction among such loops with a view to generate insights on the complex or generative causal mechanism (152). The CLD in turn informed the case analysis. Thematic codes and their relationships in terms of themes and causal loop diagram were further refined and validated with stakeholders at each of the case study sites and at national level through sense-making workshops. *Dedoose (Socio-cultural Research Consultants)* and *MS Excel 2016 (Microsoft)* (171) were used to manage the qualitative data (170) and *Vensim (Ventana Systems Inc.)* was used to build CLD (172). Formal ethical approvals were obtained from the Massey University Human Ethics Committee

(SOA 16/37) and Nepal Health Research Council Ethics Committee (Reg. no. 163/2016) respectively, and the research was conducted accordingly.

Results

Three key interrelated themes were identified and highlighted the challenges that the health system in Nepal has in addressing NCDs. In particular, these themes illustrated the critical aspects of the health system that needed to be focused to effectively and efficiently address complex challenges like NCDs.

NCDs prevention policy structure ineffective and under-resourced

Most of the key informants understood the complexity of what causes NCDs and the inability of the health system to address them adequately within the current policy and system structure. Participants pointed particularly towards ineffective leadership and lack of functional policy structure that hinder initiating NCDs-related preventative action at the policy level. One policy level key informant succinctly explained the curative orientation as follows:

> *"Curative Service Division is leading this fight against NCDs but more from curative perspective and less from health promotion." (ID: 15; Policy level; Health)*

This prevention policy gap has translated into health promotion for NCDs in Nepal getting low priority with minimal resources allocated, despite knowledge about the need for prevention and potential of available resources.

> *"Finance Ministry do not provide enough resources despite huge amount is generated from tobacco tax." (ID; 14; Policy level; Health)*

Whilst there has been some progress at the policy level in the formulation of the tobacco and alcohol control laws and regulations, there was a paucity of coordinated policies and actions for controlling the sale, quality and practices of junk food. The public health actions were often mismatched with other sectoral activities in relation to junk food as indicated by one policy stakeholder:

> *"We are advertising junk food as well as showing health messages at the same time. There is no real mechanism of control of advertisement in prime time."*
> *(ID: 17; Policy level; Non-health)*

Further, stakeholders reported there was a lack of adequate infrastructure and environment for physical activity promotion, especially in urban areas. Urban areas of Nepal have had poor urban planning, which has meant there are limited green and open spaces for promoting physical activity among the residents.

> *"What has happened is lack of open space has become an increasing problem because of population growth and exposure to open space is diminishing /decreasing. This leads to decrease in people's habit of roaming, walking, exercise and lack of good/high oxygen concentration. This trend is slowly increasing even in rural areas and condition has worsened in urban areas."*
> *(ID: 11; Policy Stakeholder; Health)*

Political instability and commitment issues were also highlighted as having an important influence on health system performance. Political interference and frequent transfer of the health workers within bureaucracy often impacted the long-term plans. A policy level participant identified lack of leadership and vision from political leadership as a key barrier to effective and sustained action:

"There is lack of genuine political parties in taking a lead for drafting the plans and policies (for multi-sector approach) which hampers the overall system. As well there is no consistency among these political parties." (ID: 12; Policy level; Non-health)

Overall, most of the key informants indicated that there had been limited focus on prevention of NCDs at the policy level. The Ministry of Health was dominated by curative orientation, and the structure and governance for NCD prevention was lacking effective multi-sectoral action.

Functioning and management of district health system ineffective in addressing NCDs and their risks

The district public health offices of the case districts did not have any concrete NCDs prevention programmes and received minimal funding for the implementation of such NCDs-related behaviour change campaigns in the case districts.

"They [Centre] provide Rs 25000, just enough for 5 institutions [for behaviour change campaigns] but what about the remaining 19 institutions." (ID: 26; Morang District; Health)

Health workers, community health workers (CHWs) and Female Community Health Volunteers (FCHVs) did not have any training in the case districts relating to NCDs prevention and screening.

"I have received only trainings on communicable diseases from DPHO." (ID: 41; Urban Bhaktapur; Health)

Despite progress in the formulation of tobacco- and alcohol-related regulations, the multi-sectoral efforts and coordination to control tobacco and alcohol use was weak and delayed at district level. A rural health worker shared that weak monitoring and enforcement of tobacco and alcohol control initiatives were leading to unabated demand, production and availability of such products:

> *"Implementation of tobacco control policies is not effective at all. Is 500 meters no-sale near school effective? It cannot be possible under current system." (ID: 35; Rural Bhaktapur; Health)*

A major concern raised by some participants was the current state of the district health and social system in Nepal. Mismanagement was leading to poor functioning of local health and social institutions and programmes, including lack of accountability and transparency.

> *"Often development budget are expended and finished in the last few month of the fiscal year and this has no any impact or output. Lack of accountability and transparency is hurting." (ID: 20; Policy level; Bhaktapur)*

A health worker claimed that many health programmes were not being conducted properly on the ground level by the local health institutions:

> *"Our [health] programmes are increasingly being fake or partially fake. People make reports without doing programmes or doing a sub-standard programmes." (ID: 35; Rural Bhaktapur; Health)*

Most of the key informants agreed that the district health system of the case districts was severely limited in its capacity to provide NCD-related services.

Health system's role in impacting overall equity and access to services

Many policies and programmes have been formulated to improve the access of general public to services but they had done little in terms of actually reaching the unreached and impacting the health inequity. A key informant stated:

> *"Universal health coverage, health equity, and social justice are mentioned in our health policy but they have just been limited in slogans only." (ID: 5, Policy level)*

Some key informants reported that services were easily accessible to those who were powerful and educated within communities, while the poor always faced difficulties in accessing quality services. A policy level informant added:

> *"Still today, despite favourable policies, people do not have access to free medicines; community people do not know what type of free medicine available. Our system is elite, it favours elite people." (ID: 20; Policy level)*

A policy participant shared that there was an urgent need for an equitable health system model that was more participatory and supported by all political parties for addressing the current inequity.

> *"A model should be prepared where nation should be responsible for poor and underprivileged and for others family, society, political parties and those who have enough resource should help." (ID: 12; Policy level key informant)*

Despite health system rhetoric for equity and access, the services were still out of reach to those in need according to many key informants.

Systems diagram of the interaction of the health system determinants of NCDs

The themes presented the interrelated possible relationships of the health system issues contributing to NCDs. We used the process of developing a Causal Loop Diagram (CLD) (figure 17) to illustrate the possible dynamic interactions of the health system determinants of NCDs. The CLD reflected the health system gaps in addressing NCDs and their social determinants in the form of dynamic interactions among the social determinants. The model illustrates three key sub-systems that are driving the key behavioural risks (use/addition of tobacco/alcohol, intake of junk food and high salt diet, and limited physical activity) of NCDs. Sub-system one (loops formed mainly by bold arrows such as primary prevention delay, screening delay and treatment delay) highlights the gaps and delays in preventative actions from the health system to curb behavioural risk factors as discussed in the first and second themes. Sub-system two (loops mainly formed by dashed arrows) presents the demand-supply sub-system that highlights the universal availability of tobacco, alcohol and junk food due to a weak health system and socio-economic circumstances, which again reflect the first two themes. Sub-system three (loops mainly formed by dotted arrows such as socio-economic effect loop and migration loop) demonstrated how socio-economic circumstances were influencing the other two sub-systems in reinforcing the NCDs epidemic, especially among the poor and vulnerable groups and contributing to health inequity (third theme). The three themes have clearly reflected the curative orientation of the system leading to limited focus on prevention and multi-sectoral action, and missing opportunity to impact health inequity.

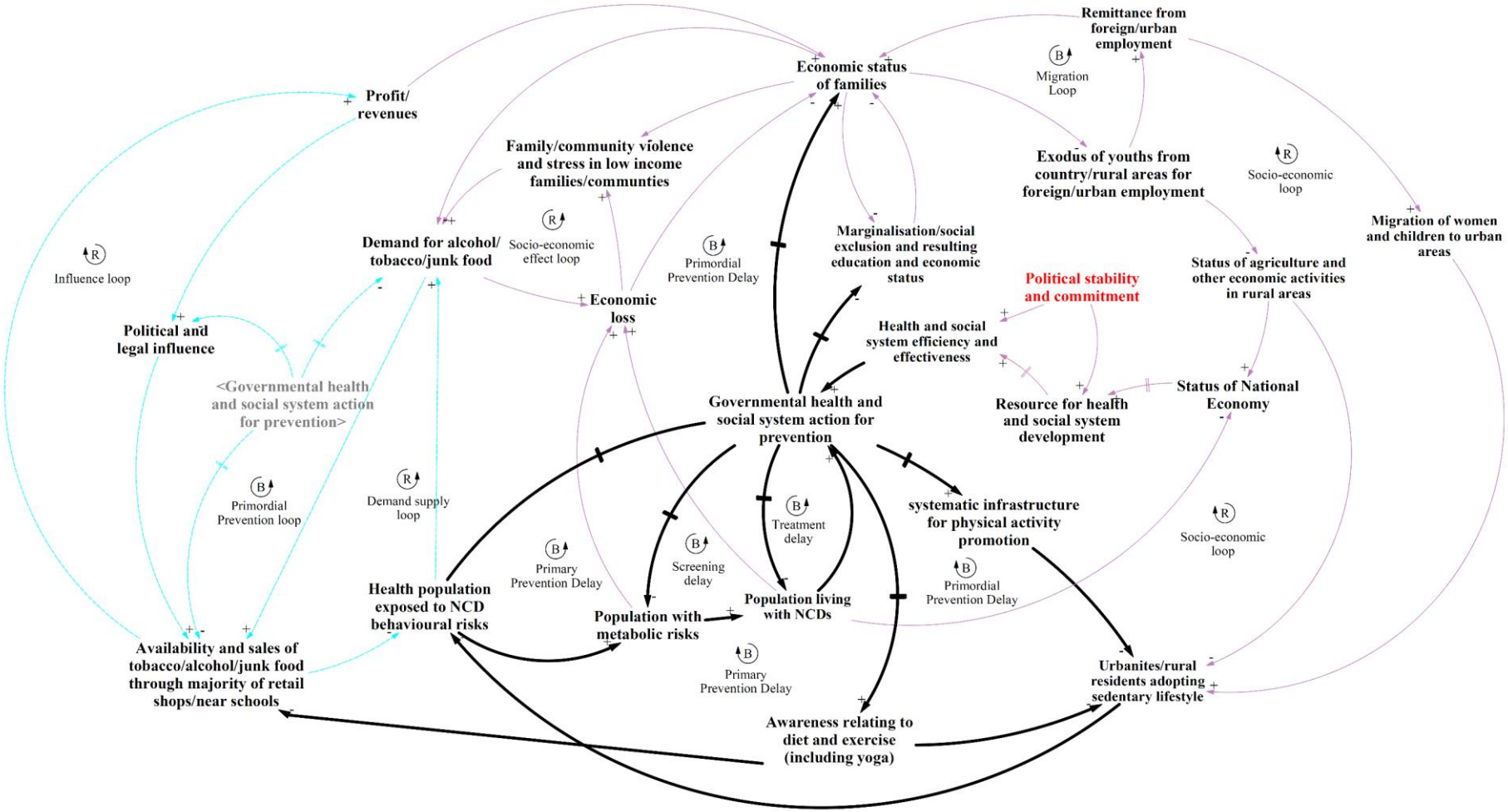


Figure 17. Final CLD of the interacting social determinants of NCDs in Nepal

Discussion

The results presented a clear picture of the challenges that the Nepalese health system faces in addressing NCDs. This section compared the results of this paper with existing evidence to draw valuable insights and generate some recommendations for health system action. There were some notable limitations, including cross-section study design, which may have missed in-depth understanding of the complex issue offered by ethnographic and/or longitudinal studies. Further, limited participation of multiple sector stakeholders in sense-making workshops may have weakened the feedback process. However, the paper was able to shed some light on the critical role of health system as the social determinant of NCDs.

Curative orientation of health system leading to limited focus on prevention of NCDs

Sub-system one in the CLD indicated curative orientation of the health system. Curative orientation of the health system was being driven by many factors as shown in the CLD and discussed below.

Results showed that much-needed resources for NCDs prevention in Nepal were simply unavailable due to this predominant mindset of considering NCDs as a curative service agenda. In Nepal, a large share of the health budget is being allocated for hospitals, patient care and development of clinical human resources compared to prevention of NCDs (77). Further, the curative orientation was also being reinforced by the current health system structure and priorities, which largely focused on addressing communicable diseases and maternal and child health issues despite the rise of NCDs diseases (13, 72, 320, 323-325). The health system has been unable to adapt to this epidemiological shift from communicable diseases to NCDs. As argued earlier in the

paper, such orientation leading to limited attention to NCDs prevention has been widely observed across many LMIC where maternal and child health and communicable diseases agendas still predominate (272-274).

While Nepal has recently started *Package of Essential Non-communicable Disease (PEN)* interventions developed by WHO, such packaged programmes are more focused on measuring blood pressure and blood sugar level and administering medicines than preventing behavioural risks and broader determinants. This is a typical example of both curative orientation as well as selective primary health care approach operational in LMIC. Experts argue that such a selective approach tends to mask the health system inefficiency and poor management and is often criticised as a failed strategy (326)

The first two themes and sub-systems one and two in the CLD indicate limited policy formulation in the areas of diet and physical activity promotion and lag in policy implementation of tobacco and alcohol control by the health system. Many LMIC, including Nepal, have developed a national plan and strategies focusing on multi-sectoral action (127, 129, 130), but most plans are not effectively implemented (13, 236). Nepal is among those countries with comprehensive tobacco control law but poor enforcement, resulting in wider availability of the products and a high percentage of tobacco/alcohol usage (13). Similar findings have been noted in countries where the laws are poorly implemented (235-237). In contrast, those countries (often HIC), where tobacco laws are strictly implemented, the tobacco use and related health problems have been dramatically reduced (238). The situation in LMIC is further worsened by the increasing evidence showing that big tobacco companies have shifted their focus towards youths in LMIC due to the decline in sales in HIC (125, 227).

In relation to junk food consumption, LMIC are often very far behind in terms of legislation and implementation. While HIC are gradually tackling the junk food epidemic, LMIC do not have the resources or capacity to moderate changes in food environments and mitigate the harms of the easy access to junk foods. The junk food companies, similar to tobacco/alcohol companies, target LMIC, especially children and adolescents (125). The study indicated that physical inactivity is becoming a growing problem in Nepal, and is linked to urbanisation and its influence in rural areas. Research from rural India and Bangladesh has shown a decreasing pattern of physical activity in rural areas due to increased motorisation, access to roads, and decline in agricultural activities (296-298). Further, as expressed by key stakeholders in this study, poor systematic infrastructure, limited green spaces and pollution have been contributing to poor physical activity around the world (276, 277).

Management and leadership issues at both policy and district level affecting equity and access to services

The third theme and sub-system three in the CLD indicated critical links between socio-economic circumstances and exposure to NCDs risks. The functioning and management of the overall health system were reinforcing the link in terms of widespread health inequity and limited access of the health services. The health system in Nepal has historically experienced lack of accountability, corruption and poor management issues, which are causing inefficiency in health and social development programmes (89). This is similar to other health systems in LMIC (240-242). The rural population, already disadvantaged by low socio-economic conditions, is further disadvantaged by a poor health system, which is often ill-equipped and has limited human resources for helping to achieve equitable healthcare access and impact social development.

The results from this study has shown that the District Health System in Nepal continues to be ineffectively and inefficiently managed, despite evidence of such poor management practices more than two decades ago (50). Poor management and lack of leadership have been often cited as the main issue of the District Health System in LMIC (327-329). Further, Nepalese health promotion actions are predominantly led by community-based health workers and volunteers. Although there has been substantial advocacy for involving the community health workers (CHWs) in the NCDs prevention programmes in LMIC like Nepal (51, 52), it is apparent that CHWs are already overburdened and demotivated (54, 55). In Nepal, community-based activities such as mothers' group meetings and out-reach clinics are already on a decline and there is an urgent need to restructure and re-strengthen the current community-based healthcare delivery system, especially when dealing with complex problems like NCDs.

Curative orientation and chronic management issues within the health system are creating barriers for effective multi-sectoral action for the prevention of NCDs risk factors. Without a shift in the mindset of the system towards tackling social determinants of health, the current restructuring of the health system in Nepal would again neglect the prevention of NCDs. It is widely acknowledged in the global health field that NCDs prevention is already lagging behind in effectively tackling NCDs (47, 143, 316, 318). What is needed is an appropriate prevention structure and preventative action guided by systems thinking [collectively also termed as prevention system (330) or system of prevention (331)]. Such a prevention system would enable timely understanding of complex problems and initiate preventative actions through multi-sectoral engagement.

Notably, the health system of Nepal is currently undergoing structural and functional changes due to adoption of federalism, which presents a great opportunity to strengthen the prevention system (20). However, Nepal is yet to utilise this opportunity for NCDs prevention and there are fears that this opportunity will never be utilised due to fundamental reasons including curative orientation and lack of systems perspective (332). The challenges discussed in the paper are still relevant for the new structure as the challenges are fundamental and need a mindset shift among the policy makers. Development of a robust prevention system, which is based on the vision of a comprehensive primary health care approach, could be the appropriate direction in tackling challenges like NCDs. The Nepalese Ministry of Health could play a significant, proactive role in guiding all sectors towards collective action to impact social and commercial determinants of health based on the comprehensive primary care approach.

Chapter V: Discussion

This chapter reflects on the methodology adopted and the main findings in this study. It presents how systemic intervention methodology and observation (findings) contributed to answering the research questions outlined in Chapter I. In addition, this chapter discusses the three key interrelated leverage points from the interpretation of the final CLD (in paper 4) for preventing NCDs in Nepal utilising Donella Meadows' framework (figure 8 in Chapter III).

5.1 Background

The motivation for this study originated from my own experience of the rising burden of NCDs among friends and families in Nepal. Due to my experience of working in the health system of Nepal for some years, I was aware of the limited capacity of the health system to deal with this growing burden of NCDs. The Nepalese health system has been structured to deal mainly with communicable diseases and maternal and child health promotion (273). These services have historically been delivered by networks of primary health care institutions throughout the country based on a selective primary health care approach. While some basic treatment services were available at these primary care facilities, NCDs as well as metabolic risks were not screened and prevented until recently (details in paper 4, Chapter IV).

Despite some recent focus in preventing NCDs, the Nepalese health system is nowhere close to tackling NCDs effectively (13). The findings from this study have demonstrated the dynamic complexity of the social determinants of NCDs and their interdependencies. The findings highlight how recent approaches which have focused on preventing behavioural and metabolic risks are not sufficient on their own. What is needed is the transformation of the health system and addressing the root commercial, environmental and socio-economic causes of health and social inequity. The findings have also illustrated the experiences of communities and families affected by NCDs. The findings particularly shed light on the experiences of low income communities, women and marginalised ethnic groups. The perspectives portrayed in this thesis add weight to arguments as to why and how the health system should think beyond behavioural risks to identify root causes (i.e. social determinants) driving risk behaviours with health system itself being a critical social determinant of health.

This chapter will a) reflect on how the systemic intervention approach contributed in answering the research questions for this study, b) provide reflections on the findings of the study, and c) discuss key leverage points for action on the social determinants of NCDs.

5.2 Reflection on the application of systemic intervention approach

Historically, public health research has focused on quantitative approaches which sit within a positivist paradigm (333, 334). Qualitative research has often been viewed as the poor cousin. In recent years there has been a growing understanding of the importance of qualitative research in public health, in particular for making sense of context (333-336). This shift to appreciating the role and insights gained through qualitative research has been slow within LMIC, resulting in a paucity of such research (337). Mixed methods, and ways of gathering insight about context are becoming more commonplace, as are the methodological perspectives that underpin them. These perspectives such as interdisciplinary, systems thinking, boundary analysis and marginalisation are increasingly being emphasised within public health research (162, 338, 339). The SI methodology adopted for this study has helped to both better understand the complex issue of NCDs and is aligned with this changing research practice within public health (161, 162). A methodology based on systems thinking approach being adopted for this study was indeed a departure from the traditional training that I received but was an enlightening process overall.

As discussed in Chapter III, the SI approach provided the methodological guidance as it suited the purpose of the study in understanding the complex issue of NCDs and their social determinants. The SI was a pragmatic and flexible methodology that enabled an

effective combination of case study approach (163) and with qualitative system dynamics method (causal loop diagram) (152). Both methods complemented each other, which reflected the methodological pluralism construct of SI. Expertise within the supervisory panel relating to case study and system dynamics method ensured that the methods were effectively combined in understanding the complex issue of NCDs. It was a satisfying experience to not only understand the underlying causal interactions of the social determinants but also be able to illustrate them in the form of systems map or causal loop diagram (152). The case studies not only helped to identify the feedback loops by helping to assign the sign of each bivariate pair or themes and the polarity of the emergent loops; the systems map also showed how best to structure the thematic analysis. The systems map development process was iterative and thus allowed for moving back and forth in the analysis to improve both the case analysis and the causal loop diagram.

In relation to boundaries of analysis (161, 162), the adapted SDH framework created the broader boundary of the study. However, during the analysis, these boundaries were shaped by the local context and experience and perspective of the participants of the study. Pertinent issues (i.e. major themes) that emerged during the data collection and analysis have been elaborated in Chapter IV. Different possible boundaries, in terms of stakeholders (policy, district, and community level), community respondents (advantaged and disadvantaged groups) and geographical context (Terai vs hills), were considered to adequately understand the issue.

SI emphasises the prevention of marginalisation of both issue and stakeholders (162). The marginalisation of NCDs prevention by the health system due to curative

orientation and lack of a supportive system structure has been already discussed. A key aspect of preventing marginalisation of the issue in this study was to ensure data were collected from the disadvantaged communities and ensure their participation in the sense-making workshop. In each of the case districts, disadvantaged communities were identified in consultation with District Public/Health Offices and local stakeholders and subsequently, focus group discussions were held in such communities. Local stakeholders were invited to participate in the interviews and the sense-making workshop of the preliminary findings of the research. Ensuring the meaningful participation of disadvantaged communities and stakeholders in the research was critical for this study. The research approach ensured that the voices of the the marginalised were captured and key stakeholders engaged. For example, in paper 2, it was quite a revelation that disadvantaged ethnicity were utilising their traditional skills to produce alcohol to support their livelihood. During a focus group discussion, one of the participants (disadvantaged ethnicity) shared that she was compelled to sell tobacco and alcohol as they sold the most and supported their basic needs. During the sense making workshop, stakeholders validated and provided further insights on the socio-economic circumstances of the disadvantaged communities that was leading to the illicit trading of home-made alcohol.

Systemic intervention approach could be one of many critical systems approaches to understand and address complex problems. Health system could benefit from this critical public health research approach to engage with low socio-economic group to improve their health status (340). The findings of this thesis clearly show that the health system is failing to impact health inequity. This study can provide impetus towards

utilising similar systems science methods and tools in public health research and practice, which often have to deal with complex problems.

However, the SI approach applied in the current study may warrant more time to build relationship with community and agencies and develop a shared understanding of why their participation was critical in all stages of research process. Further, more time would have provided opportunity to empower the communities and strengthen the co-developed systems thinking perspective about the NCDs problem and potential leverages for action. Empowerment is a long-term process and this study was only partially successful in wholly adopting the SI approach to empower people during the short duration of the research.

Similarly, the sense-making workshops were organised at District Health Offices. Most of the participants in the workshop were from the health sectors and there was a low turnover of the stakeholders from other sectors. This can be linked to the trend of limited engagement and participation of the cross-sector stakeholders in public health initiatives indicating marginalisation of public health issues as a key multi-sectoral agenda. More time and effort were needed to make the SI approach work and enable engagement of diverse stakeholders effectively in the context of Nepal.

The SI approach has been defined as purposeful action to create social change with observation as a first step of intervention (161, 162). This study has accomplished the observation part of the systemic intervention. I have plans to translate these observations of social determinants of NCDs into interventions in line with the systemic intervention approach (observation as the first step of intervention) through the support

of a local NGO in DIYASU Community Development Centre. The NGO would start some initiatives to address key leverages that are identified later in the chapter. For example, the NGO is trying to initiate some social entrepreneurship projects engaging low income and disadvantaged women groups such as low cost sanitary pads and community gardening, and support the livelihood of the families of those women along with contributing some profits for the NGO to conduct health campaigns.

5.3 Reflecting on the social determinants of NCDs

The four results papers discussed how social determinants interacted at multiple levels in escalating the problem of NCDs. In line with the first two research questions and related objectives, the results have highlighted the dynamic interaction of the determinants of NCDs from a systems perspective and have helped in understanding the challenges for NCDs prevention in Nepal.

In this study, the major determinants identified were income, gender, geographical location, risk behaviours and health system that dynamically interacted to perpetuate NCDs problems in the case districts. Many public health research have linked risk behaviours as key determinants of NCDs but do not go beyond those intermediary determinants (9, 204, 225, 341). While some have gone beyond those intermediary determinants linking broader determinants such as income or education with NCDs or their behavioural risks (42, 179), they do not illustrate how these key determinants interact and influence each other. The dynamic perspective and insights on the interaction of social determinants are often missing which are critical for understanding and addressing complex problems like NCDs (342). The systems map or CLD model (figure 17) illustrated how the progression of a healthy population towards

unhealthy/disease sub-groups was being driven by interactions of social determinants such as socio-political situation, industrial influences, socio-economic status and health system actions at different levels. Such illustration is important for two reasons: to develop a holistic understanding of the complex issue of NCDs prevention and identify potential leverage points for local and policy action. The *Foresight Project* for obesity prevention and *The Initiative on the Study and Implementation of Systems* for tobacco prevention are some key examples that have used similar systems approach to develop critical insights and identify leverages for action (155, 156).

Tis PhD study showed how NCDs were affecting communities not only in terms of health, but also social and economic consequences. These stories of the social and economic effects of NCDs can be gleaned from the papers in Chapter IV. For example, a common major theme in paper 2 was that poverty was a key root cause of addiction/use of tobacco and alcohol products leading to NCDs. Poverty is commonly recognised as key determinants of public health problems including NCDs (47, 343), however, the traditional public health researches often do not discuss enough about such complex and broader determinants. It can be argued that discussing influence of poverty on health issues is complex and one of the limits of the traditional public health approaches. In this study, systems perspective helped to make sense of potential feedback loop operating at community level relating to poverty. From the qualitative narratives and CLD in paper 2, the multiple interactions of poverty with both demand and supply of tobacco and alcohol products were identified.

The socio-economic situation was leading many low-income communities to produce low-cost home-made alcohol using the traditional skills to support themselves. Further,

NCDs were pushing families into poverty as the household income were being utilised towards covering the expenses of NCDs treatment. Evidence of families being pushed to poverty due NCDs is substantive (344). Such NCDs induced poverty would directly affect the development of the children from such households in terms of limiting resources for education and care of the children which perpetuates the intergenerational cycle of poverty and ill health. Such intergenerational or vicious cycle of poverty and poor health is increasingly highlighted within public health research and practice (47, 344-346) and this PhD study has contributed to the research approach aiming to capture the poverty-disease narratives and illustrate them in terms of systems map or CLD.

This PhD study showed that socio-economic status was influencing the diet and physical activity practices in multiple ways. Population of all socio-economic groups were being affected by diet and physical activity risks. However, there was an indication of social transition of unhealthy diet and inadequate physical activity mainly affecting low socio-economic groups. A Lancet article has also noted start of such social patterning in LMIC (270). This PhD study also indicated that due to poverty and underdevelopment in rural areas, many Nepalese were rapidly migrating to urban areas and foreign countries, which was exposing the migrants and their families to urban influences of junk food diet and limited physical activity. In particular, Nepal is considered as a hotspot for cheap labour migrant workers for richer countries like Dubai, Qatar and Malaysia (347, 348). This study indicated that the families of the labour migrants accordingly migrate to urban areas for better opportunities and this has resulted in huge proportion of vulnerable migrant families being exposed to obesogenic environment in urban Nepal. This migration has also impacted the agriculture in rural areas in terms of unavailability of agriculture workers and decrease in agricultural

activities as indicated in the third paper. The World Bank data showed that the share of agriculture in the gross domestic product continue to rapidly decline despite significant (but declining) population still engaged in agriculture. (306).

Despite some recent progress in the prevention of NCDs in Nepal (13), the health system potential of addressing social determinants of NCDs remains bleak. First, the health system has its own sets of issues including poor management and limited resources for preventing NCDs as indicated in the papers. Second, attention on the broader determinants such as the socio-economic situation on population health has never been a priority. Complex problems like NCDs are still considered as a behavioural and medical problems that can be addressed through packaged interventions (13, 349). Action on the broader determinants remains of low priority. While international agencies and experts continue to advocate reorienting focus on collaborative and multi-sectoral approach led by health system for NCDs prevention (6, 47, 350-353), the national response focuses on the intermediary determinants only with some high potential policy measures such as tobacco control facing familiar resistance and poor implementation (13, 235-237). In particular, the health system has not been able to internalise its potential as a leader and collaborator in influencing socio-economic and commercial determinants of NCDs as discussed within the results papers in Chapter IV.

Interestingly, the health system of Nepal was set up for promoting prevention based on comprehensive primary health care (PHC) principles of universal coverage, community participation, intersectoral coordination and commitment to health equity to address communicable diseases and maternal and child health (325, 354). Only, a

comprehensive primary health care approach can effectively address the social determinants of health (355). However, the Nepalese health system from the outset adopted selective approach (focus on low-cost medical and technological packaged solutions) due to its quick outcome and related socio-economic and political facilitators (326, 356). Selective approach tends to mask the poor management and inefficiency of health system and drift the goal of the health system from achieving comprehensive primary health care towards ensuring selective reach of medical and technological solutions (discussed in paper 4) (326). As argued in paper 4, the PEN intervention, which is being scaled up to prevent NCDs in Nepal, will also be ineffective from a systems perspective as it will focus on administering medicines to prevent metabolic risks and neglect strategies to tackle broader determinants. Such a selective approach will continue to mask the system inefficiency and push the system into a vicious cycle of ineffectiveness in the context of Nepal.

One main reason for this selective or medical orientation of health system in countries like Nepal is due to difficulty in practicing prevention, as it demands coordination and joint action across sectors and often the benefits are invisible and delayed (357). It is often hard to make political and economic arguments for such invisible success for NCDs prevention (For e,g. promoting healthy diet and formulation of alcohol control policy) against visible medical success such as establishing a tertiary care hospital or ensuring free medicines from local health facilities in the context of Nepal. In addition, resources have always been an issue within the health system of a low-income country, especially resources for preventing NCDs (143). Within the limited health sector resource allocated for NCDs, more resources are being expended on curative care due to the urgent nature of the support that a person suffering from cancer or stroke needs. This

creates a vicious circle of resource allocation for curative care of NCDs, thus impacting resource allocation for prevention of NCDs (as argued in the result papers).

5.4 What are the potential levers for change?

The third research question and objective of this study (in Chapter I) was to identify the potential leverage points for health system actions against the NCDs epidemic. The final CLD model (figure 17 in paper 4) presents the consolidated picture showing interactions of the key social determinants of NCDs and indicates various potential levers, including health promotion campaigns, formulation of new public health policies, multi-sectoral action, health system leadership and political commitment. However, three key variables were driving or controlling multiple feedback loops i.e. these driving variables had high concentration of linking arrows as indicated in figure 18. These three variables were *Economic status of families, Governmental health and social system action for prevention and Availability and sales of alcohol/tobacco/junk food* and have been highlighted within the below figure. These variables have been discussed implicitly and/or explicitly within the papers but they are elaborated here utilising Meadows' framework (discussed in Chapter III) (173, 175).

Two of the leverage points (*Economic status of families* and *Governmental health and social system action for prevention*) were considered deep leverage points while one of the leverage point (*Availability and sales of alcohol/tobacco/junk food*) could be characterised as a shallow leverage point based on Meadows' framework. The three interlinked levers have provided a potential guiding framework for action on the social determinants of NCDs in Nepal. Accordingly, intervention strategies aimed at these

levers are discussed below for their potential to create effective and efficient action on NCDs prevention and system change. The three levers identified are:

1. Focussing on social and economic inequity
2. Strengthening health system leadership, functioning and effectiveness
3. Improving health of communities through both behavioural and environmental actions

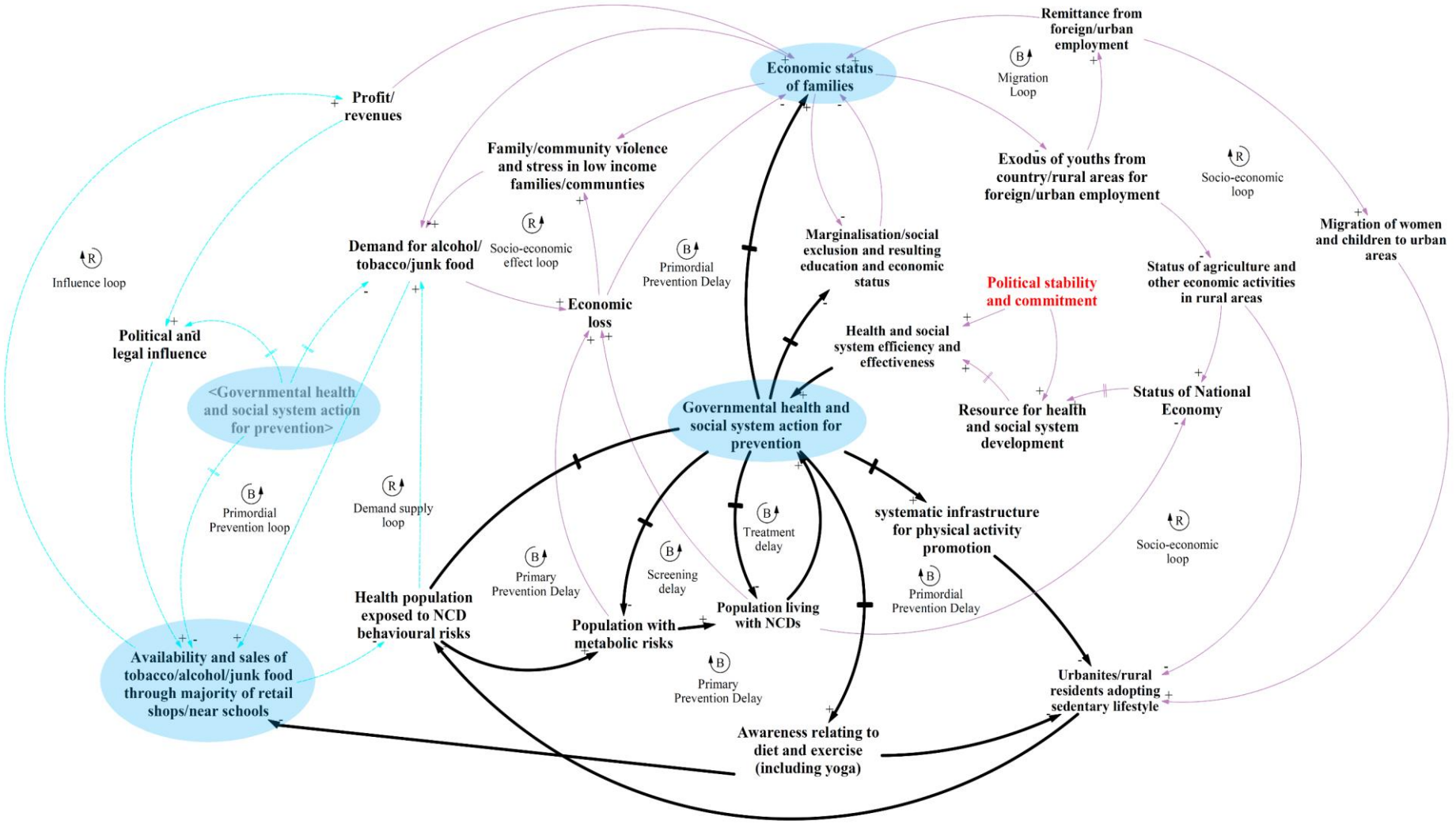


Figure 18. Final CLD showing leverage points for systemic action on NCDs in Nepal

Strategy 1: Focussing on social and economic inequity

The strategy corresponded to the deeper leverage points (i.e. goal and system structure) in *Economic status of families* variable for the health system according to Meadows' framework (173, 175). In figure 18, most of the feedback loops originating from three variables highlighted in the CLD linked the poor socio-economic conditions of the families; low income, female and disadvantaged ethnicity were among them. Socio-economic conditions were driving the NCDs issue both as a cause and effect of the NCDs problem. The high concentration of loops in the *Economic status of families* variable in the CLD also indicated that socio-economic condition needed to be focused in order to address the epidemic of NCDs in Nepal.

Making families and communities economically capable and providing preventative safety net against disease and illness such as health insurance and/or universal health coverage could be steps towards creating an equitable and just society. If the families have opportunity to improve their economic situation through work opportunities, social safety nets and creating a healthier environment, they would contribute to national progress, which would be reflected in revenues generated. This leverage point has been identified within contemporary reviews as a key component of the SDH action continuum (81, 358). One reason for focusing on improving socio-economic status of families is to provide better developmental opportunities to children, especially female children and reduce the intergenerational impact of health inequity. This study has shown how females are being denied of basic health services due to socio-cultural norms and practices. Gender consideration is thus essential to ensure females are empowered and equally involved in socio-economic interventions. Evidence from both developed and LMIC has reported cases of socio-economic interventions to improve

social determinants of health (359, 360). In particular, the *Bosla Familia* programme in Brazil has lifted many people from poverty, reduced gender inequality and provided adequate health care services simultaneously. Such programmes are needed in the context of Nepal as well.

Improving socio-economic circumstances of families and communities is a complex and gradual process and multi-sectoral efforts are needed in the endeavour. This needs a significant shift in the mindset of the whole government mechanism towards creating a system that can contribute to a prosperous and healthy society. The whole socio-political system should embrace and appreciate the interlink of health and social wellbeing and bring changes in the respective sectoral policies towards materialising the vision of a healthy and prosperous nation, similar to the popular concept of *Health in all Policies (243)*. The health system can continue to advocate across sectors for addressing those socio-economic determinants. The link of economic progress with NCDs prevention is being increasingly acknowledged (4, 361) which should provide strong basis for policy level action amid complexity of NCD prevention. Health systems should, in a strategic way, consider impacting socio-economic circumstances wherever they can through collaborating with key agencies that work in the areas of poverty alleviation, gender equality and education. The case of the South Australian state illustrates how strategic multi-sectoral approach led by health system can impact health and well-being on a longer time frame (83).

The foundation to this socio-economic and health progress should be based on the socio-political system that promotes transparent governance, economic growth and accountability and, ultimately support a prevention system approach, which can

potentially impact broader determinants of health. Due to the recent political changes, there have been increasing expectations of socio-economic development and progress in Nepal (362, 363). The new constitution of Nepal 2016 clearly states the goal of the constitution is to be a socialist country and ensure health as a fundamental right. However, the government system, including the health system, continues to be trapped into web of inefficiency, lack of transparency and corruption, and despite new constitution and progressive policies, the country has not been able to make anticipated progress (364, 365). Nepal is often ranked among one of the most corrupt countries in the world with inefficient government systems (365). Corruption and inefficiency in health and education sectors have been regularly reported across literature (89, 366, 367). This can be linked to years of political instability and short-term thinking of the political leadership. Political determinants have received some increased attention lately within the public health field (86). This study has indicated that political determinants can be significant in tackling complex problems like NCDs in terms of ensuring good governance, social sectors reform and adequate resource allocation for such social sectors.

Strategy 2: Strengthening health system structure and functioning to prevent NCDs

The second strategy to intervene, *Governmental health and social system action for prevention* variable, also corresponded to deeper levers of the Meadows framework (goal of the system and system structures) and closely linked with the first leverage point. As suggested in figure 18, the health system could play a central role in addressing the social determinants of NCDs. Appropriate prevention structure and comprehensive preventative action guided by systems thinking [also collectively termed

as prevention system (330) or system of prevention (331)] and based on the principles of comprehensive primary health care are needed for this.

However, the question of how to develop an appropriate prevention system arises. The process is gradual and needs a systems thinking-based health system strengthening approach. A bottom-up approach in developing a robust prevention system that addresses the multilevel determinants of health could be the most effective way forward. Such a prevention system may be different for each of the case districts, so it needs to be led by the district health system and developed in close collaboration with other cross-sectors (such as education, transport and local councils) that influence the social determinants of health.

In particular, a national preventative health agency for NCDs could be established to facilitate the development of local prevention system in addressing the complex problem like NCDs. Appropriate policies, structure, directives and coordination mechanism would need to be developed at the policy level, which would aid in the development of a local prevention system focusing on but not limited to NCDs. The agency could lead the efforts to coordinate with multiple sectors to curb tobacco, alcohol, physical inactivity and junk food issues and create a health-promoting environment. Such agency would facilitate coordination with universities and non-government organisations for evidence-based and local actions. While there are many examples of such dedicated central government agencies in developed countries that are doing excellent work in preventing NCDs and their risk factors with social determinants focus (368, 369), such agencies are extremely limited in low-income countries. Social determinants of health approach can only be achieved if the health system plays a

leading role in pushing health as a development agenda and ensuring all sectors are effectively engaged. The institutionalisation of a national body for NCDs prevention with sufficient resources could be a significant step among many other steps in creating a prevention system in Nepal.

The agency could provide national leadership in preventing NCDs through multi-sectoral effort. It could pro-actively advocate for resources for health promotion and NCDs prevention with Ministry of Finance and, in a way, help the Ministry of Health shift from curative orientation. This could be possible only when there is a champion leadership at the top level of health who could advocate for health in all policies targeting the complex issue of NCDs (267).

Strategy 3: Improving health of communities through behavioural and environmental actions

The third strategy to intervene, *Availability and sales tobacco/alcohol/junk food products* variable, corresponded to shallow leverage point according to Meadows' framework. The third strategy aimed to impact delays and push positive feedback/mitigate negative feedback in terms of promoting healthy behaviour and environment relating to NCDs, which are shallow leverage points in Meadows' framework (in figure 8). The Nepalese health system should urgently act on the emerging evidence relating to preventing NCDs through policy measures to curb the availability and sales of tobacco, alcohol and junk food products as well as community-based health promotion to improve knowledge, attitude and practice relating to NCDs risks and address those critical delays. Even these shallow levers are delayed in case of NCDs due to focus on curative care and limited resources for prevention. There are

already significant delays at all levels of health systems to understand the social determinants of NCDs and take appropriate actions to curb NCDs, which are seriously hampering the health and socio-economic progress of families and communities.

This study does present an opportunity for the health system to think of comprehensive health promotion and behaviour change strategies for tackling NCDs along with considering deeper levers for effective actions. Successful innovative and culturally appropriate approaches can be utilised. In particular, the research has indicated how our traditional food was nutritious but was being rapidly replaced by junk food. Interventions to revert to our practices of eating raw and self-produced food are essential, especially through policies that support home gardening, local social enterprises and counteracting the influence of junk food. These interventions must integrate the local knowledge and tradition of healthy living and reconnect to the traditional knowledge of healthy eating. Yoga and vegetarian diets are some of the culturally appropriate social practices that may need to be explored and supported through the prevention system in the Nepalese context. Evidence from both HIC and LMIC including Nepal are increasingly available to learn from and promote traditional and Indigenous dietary practices and physical activity, especially among disadvantaged groups (314, 370-375). For example, New Zealand has started to promote the traditional dietary practice and physical activity among its Indigenous population guided by Indigenous knowledge system and worldview (314, 376-378). Many Pacific countries are realising the impact of imported food onto their local food system and public health and re-emphasising shift towards traditional diet based food system (116, 285, 379).

Health promotion campaigns backed up by successful policy and regulatory actions have been found to be effective in reducing smoking (380). Such evidence relating to effective government-led tobacco and alcohol prevention interventions should be translated into the Nepalese context. Such interventions can be innovatively financed through taxation measures, which are often underutilised (381). Nepal needs to capitalise on the collected excise tax on tobacco and alcohol in resourcing health promotion interventions as well as push for the increase in excise taxes. Further, Nepalese government has already committed to develop policies relating to sugar tax but there is no sign of implementation yet.

Empowerment focused approaches are often ignored within health promotion interventions due to the complex nature of such approaches, despite their huge potential to address health inequity (382, 383). Health promotion actions can significantly benefit from integrating these cross-disciplinary approaches such as co-design or design thinking. Co-designing and systems thinking approaches have helped design health promotion interventions in HIC (370, 384, 385) and have potential to be utilised in LMIC like Nepal. Health promotion interventions could be co-designed with communities and ensured to comprise features such as local empowerment, gender-equality, evidence-based, cultural sensitiveness, co-designing, systems thinking and health equity focus.

Health promotion field has been integrating multi-disciplinary approaches from other social sciences such as psychology, economics and communications to bring about the desired behaviour change at individual and community levels (386). However, there are suggestions that health promotion field should move beyond behaviour change due to

inadequacy and limited effectiveness of traditional behavioural change approaches to tackle complex social problem, often guided by dominant psychological theories (387). Recently, there has been an increasing call for integrating social practice theories within health promotion, which is increasingly being utilised in sustainability studies to effect sustainable practice change and offer an alternative theoretical approach to change behaviour and practice of the whole community (387). Social practice theories can be integrated into existing behaviour change approaches to enable a sustainable adoption of healthy behaviour and address some of the limitations of behaviour change approaches (387-389). Health promotion field should continue to creatively explore and integrate approaches from other sciences to be effective in tackling complex social problem.

5.5 Limitations of the study

There were some key limitations of this study. This study only provides a part of systems thinking based analysis of the social determinants of NCDs. In other words, the study only highlighted how some of the major multi-level factors were interacting and contributing to the progression and distribution of NCDs in Nepal. Further, the study had some assumptions regarding the leading role of the health sector in preventing NCDs, such as leading multi-sectoral action and actively advocating for policy measures to curb risks of NCDs, which can be argued otherwise (i.e. Ministry of Local Development and local councils taking the lead). As such, this study may only present part of the complex causal mechanism of the social determinants of NCDs and warrant further studies.

Some of the determinants that were missing in the analysis included financial burden and their implications on the families affected by NCDs, lived experience of the people

with NCDs, and NCDs on children and older age groups. Further research is warranted for deeper understanding of the lived experience of those affected by NCDs and how they impact the individuals and families in the longer term. The study also dwelled on the topic of social capital to some extent but not in great depth due to limited data relating to social capital. Similarly, political influence, governance, industrial influences and corruption issues need further investigation, which were limitedly reflected in the data.

This study had some key methodological limitations. There are compelling arguments that a systems thinking approach is well suited to exploring complex issues such as NCDs but the approach is often difficult to apply (152, 174). While the WHO SDH Framework helped to shape this research, the study design and tools may have been affected by the limitations that are inherent to the SDH Framework itself, including being broad and wider in scope. Further, the participatory nature of the study was in itself a key challenge. In particular, the sense making workshops engaged participants predominantly from the health sector. This may have weakened the feedback process where we expected feedback from multi-sector participants. While we had invited the non-health sector stakeholders to the sense-making workshop, they did not come.

Qualitative research related biases may have been introduced by the researcher during data collection and analysis. Qualitative research requires strong communication and narratives interpretation skills to correctly process rich information from participants. The CLDs also mainly represent the mental model of the researcher based on the thematic analysis. However, system dynamics experts argue that a causal loop diagram based on qualitative data can provide useful insights when developed rigorously (390).

The researcher has conducted the study rigorously to the best of his ability but also feels that there is scope for improvement.

The study design guided by SI methodology enabled interpretation of a variety of information from different sources (including documents and secondary data) and from different levels (policy and implementation levels), which ensured richness and cross-validation of information obtained. The research study design was established to try and balance out the limitations of each type of data when it is used on its own and enable balance between context and generalisability.

Chapter VI: Implications, Recommendations and Conclusion

This final chapter discusses the implication of the study, recommendations, and conclusions of the PhD project. This chapter draws from the insights from the findings and analysis in Chapters IV and V to provide specific recommendations for different levels of the health system.

6.1 Improving the health system of Nepal

The study focused on understanding key generative causal mechanisms of NCDs and how they were interacting with broader social determinants to accelerate NCDs in Nepal. The study has showcased how NCDs were affecting everyone from the rich to the poor, urbanites to rural residents, from young people to elderly, and both male sand females in Nepal. The study highlighted tobacco, alcohol, diet and physical activity as parameters that were influencing the interactions among the social determinants of NCDs, including socio-economic, gender and health system factors. In particular, the current state of tobacco and alcohol use was a major problem despite some key policy measures being in place. This study found that participants had knowledge about the effects of tobacco and alcohol but were unable to take control of their addictive behaviours due to social and commercial factors in Nepal.

Systems thinking and systems methodology has been useful in generating insights on social determinants of NCDs in Nepal. CLDs and archetypes have illustrated the complex interactions of the social determinants of NCDs based on themes, which can be a starting point for systemic intervention. The SI methodology could be useful for understanding any complex issues and developing critical insights on the causal mechanism and preventative action in Nepal. There is a need for utilisation of such methodology for generating insights on how to address health inequity through system strengthening and re-orienting systems towards a focus on the complex issues and their social determinants.

This study demonstrated that the health system was limited in its understanding of and action on NCDs risks, which were almost exclusively focused on behavioural issues

rather than focusing on systemic issues. In particular, efforts to understand the political and commercial determinants of health and the linkage of poverty with tobacco and alcohol use are critical for shaping the prevention system led by the health system. Policy makers acknowledged the complexity of NCDs issues but were generally reluctant to undertake the comprehensive actions needed. This was possibly due to difficulties in coordinating and collaborating with other sectors to tackle tobacco and alcohol use and the system issue of limited resources for prevention. Further, improvement in dietary and physical activity practices need intersectoral action which engages infrastructure, agriculture and education sectors, in cooperation with efforts and resources on the part of the health system. While some key multi-sectoral actions in improving child health were being undertaken, there was still big gaps in action targeting the adult population and NCDs. It will be crucial to ensure that lessons are learned from the multi-sectoral nutrition action that could help inform further the health systems' efforts to prevent NCDs.

This research has identified the health and social systems as rigid structures that are slow to adapt to the contemporary challenges. The health system should be proactive in understanding and perceiving the looming threats in public health along with taking actions from a pragmatic systems perspective. This study has practical utility in terms of providing methodological and conceptual basis for action.

A key insight that the health system can glean from this research is how social practices concerning risk behaviours are linked with socio-economic situations and social histories of communities i.e. why and how home-made alcohol became commercially available? Why the agricultural land is now left barren in the village instead of being

utilised for agriculture? How did the traditional dietary practice change to junk food dietary habit? These issues emerged from within the historical socio-economic and political functioning of the Nepalese society and were embedded within the generative causal mechanism of NCDs. The health system needs a systems lens to carefully unpack the generative or layered causal mechanisms of NCDs, which are embedded within the socio-economic and political context.

6.2 Recommendations

The following recommendations are based on the insights gleaned from the thematic and leverage point analysis and are aimed to foster NCDs prevention actions at both implementation and policy level. Research recommendations provide future directions for public health researches relating complex issues like NCDs.

Implementation level (district and community level) recommendations

- **Prevention needs to be prioritised. The local health system led by District (Public) Health Offices (or health department in new federal states of Nepal) should be strengthened and oriented towards actions on the social determinants of health.** Leadership in collaborating with other sectors is key to achieve local multi-sectoral actions on alcohol, tobacco and junk food problems leading to NCDs. District health system will not only require knowledge and skills relating to social determinants of health but also collaboration skills to influence across sectors to integrate health considerations in their policies.

- **The community-based health systems should be reinvigorated or redesigned to fulfil the purpose of the community-based health service delivery.** The

current community-based health system, including mother's groups, Female Community Health Volunteers, Primary Health Care-outreach clinics, were clearly designed to address maternal and child health issues. A more concrete community health service delivery should be redesigned and co-designed to address new challenges like NCDs. For example, the Cuban model of primary health care through family doctors and nurses along with strong social security measures (391).

- **The community-based health service delivery should engage with local communities in co-design and re-design processes to enable more people-centred delivery approaches.** This would ensure more equitable utilisation of services, initiate local action to improve unhealthy environment (availability of tobacco, alcohol and junk food products) and ultimately impact local health inequity.

- **Local health workers should collaborate beyond their traditional disease prevention role to advocate how health is being shaped by other factors, including socio-economic situation, gender discrimination and access to education within communities.** Some key community level actions that health workers at local level could initiate include promoting girl child education, advocating against gender-based discrimination, and promoting community-based social enterprises. These small steps would all contribute to positive shaping of social determinants of health at local levels especially in a low resource setting.

Policy recommendations

- **Health policy actions should demonstrate leadership in strengthening the health system towards the development of a prevention system that improves the health of communities.** With rapid increase of NCDs and the current mindset of the health system being dominated by the medical model of health promotion, the leadership at policy level is crucial to transforming the health system towards adopting prevention system to tackle NCDs in the communities. In particular, there is need for system restructure that can facilitate systemic actions for NCDs prevention. The Ministry of Health should set up a national agency for NCDs for addressing the NCDs and their social determinants through inter-sectoral actions, a key suggestion from leverage point analysis.

- **The health sector should liaise with other sectors to foster shared actions of social determinants of health through the national agency.** NCDs are a complex issue and require continual coordination with other sectors in a credible, salient and legitimate way. The health sector should not only share evidence on how socio-economic, political and other broader factors affect health but also proactively engage with other sectors to develop a shared understanding of the causal mechanism, foster ownership on the issue, and eventually align health system programmes with those of other sectors. For example, the health sector should transform their traditional approach of service delivery (medical model) to actively engage with the education sector for ensuring school curriculum includes contemporary public health education or engage with municipality and police to tackle social practice on tobacco and alcohol use or supporting and advocating for socio-economic opportunities for

youths and marginalised communities. This is only possible if leadership at the health sector appreciated the social determinants of health perspective and were motivated to adopt this difficult route to preventative actions on NCDs.

Research recommendations

- **More localised qualitative and/or mixed-method research (especially in the context of LMIC such as Nepal) guided by systems science is needed to critically understand complex health and social challenges.** Such challenges are embedded in local context and require localised solutions. This research provides cues for such localised social determinants of health research. For example, a case study of lived experience of poor and vulnerable would have highlighted circumstances leading to NCDs in poor and socio-economic difficulties faced by those suffering from NCDs. Research relating to community resilience and its dynamic interaction with local prevention and public health infrastructure could help strengthen local prevention system.

- **Systems research needs to be more widely utilised and well-coordinated among local university and research organisations and communities.** This will also help to develop organisation capacity to conduct systems research and foster systems thinking in public health research and practice in LMIC.

Figure 19 presents a prevention system framework based on the above recommendations that could potentially guide the health system of Nepal in tackling social determinants of NCDs. The structure of the recommended prevention system needed to tackle social determinants of NCDs including essential foundations for such a

prevention system is illustrated in figure 19. The structure of the prevention system proposes that coordinated preventative actions engaging all levels of health system is essential to tackle NCDs. The national agency to prevent NCDs is pivotal to accelerate localized action on the social determinants of health led by district health system. Community-based health system based on PHC principles should form the basis of the local SDH action.

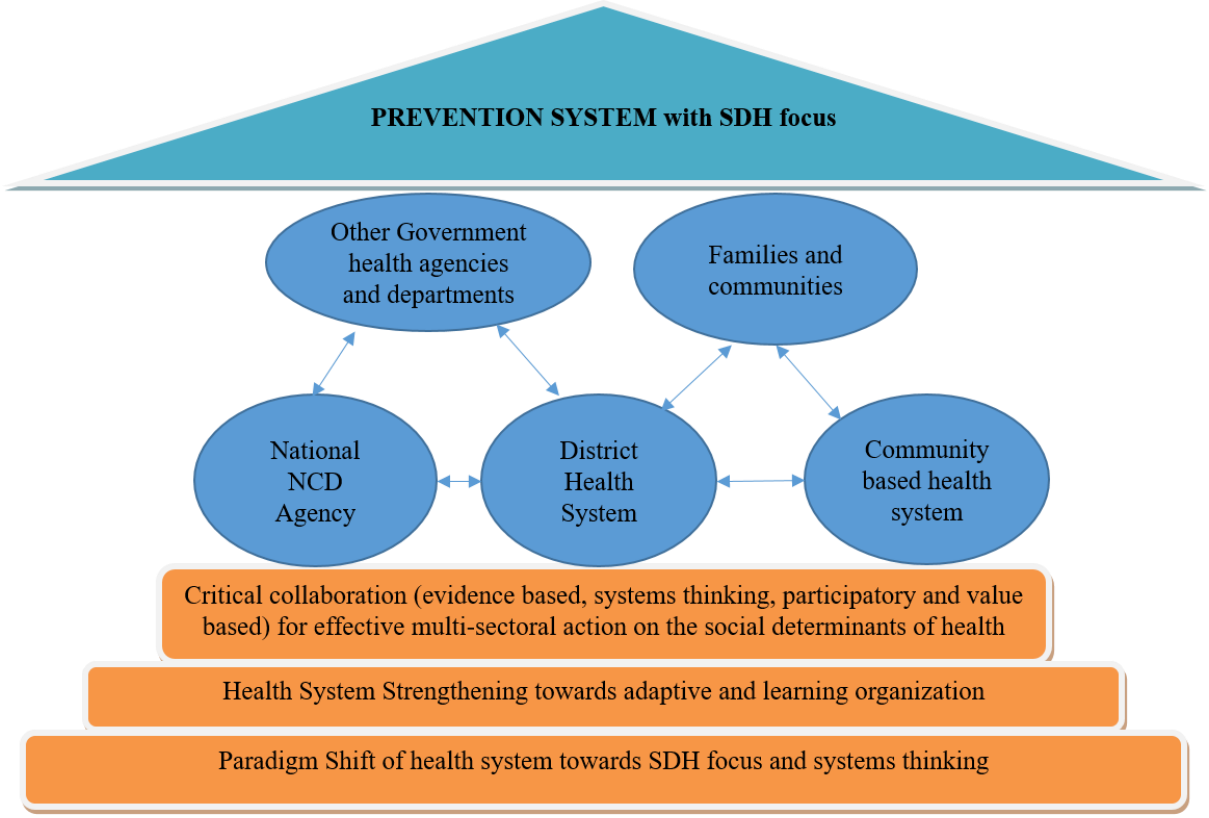


Figure 19. Recommended prevention system framework to tackle social determinants of NCDs in Nepal

Three key foundations that consolidate the structure for the proposed prevention system is also illustrated in figure 19. These foundations are: paradigm shift of the health system towards SDH focus and systems thinking, health system strengthening towards adaptive and learning organization, and critical collaboration for effective multi-sectoral

actions. Preventative actions guided by these foundations are essential for tackling complex problem in NCDs. Health system should gradually shift the policy and practice at the highest level through policy and structural reform that facilitate adoption of social determinants perspective and systems thinking. The first step could be to carry out a national review of the social determinants of health and NCDs. In addition, key policy stakeholders could be oriented on the perspective and evidences relating to the social determinants of health. Simultaneously, guidelines to integrate SDH consideration in public health programme planning could be developed. Strategies to strengthen health system not only enables the system to identify contemporary challenges but also increases the adaptability of the health system to effectively and efficiently tackle complex problems. Health system strengthening thus should be geared towards improving bottom-up functioning of the health system, identify local health challenges and take community-based actions based on the principles of primary health care. Critical collaboration emphasizes on critical system thinking based intervention by different sectors to tackle complex problem. Critical systems thinking approach helps to develop a shared perspective of complex problems among stakeholders and facilitate development of joint action plan for effective cross-sector action (392). In other words, the critical collaboration approach not only enables a holistic understanding of NCDs issue, but also provides equal voices to those engaged on how to tackle NCDs, thus addressing power dynamics and marginalization during the collaborative process.

6.3 Conclusion

In this interconnected, dynamic and complex world, systems tools are needed to understand and manage complex issues like NCDs. The systemic intervention approach is a useful approach that is gaining traction in understanding complex phenomena from

a holistic as well as local perspective. The systemic intervention approach may take years to be effective but the process itself is empowering and enables stakeholders to develop a comprehensive understanding of the social determinants of a complex problem. The SI approach enabled the development of causal loop diagrams through thematic analysis and illustrated the complex causal mechanisms for NCDs in Nepal as well as identifying levers for action. This could be a starting point for reflecting within the long-term plans and strategies towards a healthier society. The study was able to identify the complex relationships in the form of CLDs and related these to relevant system archetypes, which can aid the stakeholders in planning preventative actions.

Key social determinants of NCDs have been highlighted and how they interact to produce the problem of NCDs being experienced in Nepal. The study highlighted the socio-economic, gender, commercial and health system factors driving NCDs. The dynamics interaction illustrated by CLDs and archetypes showcased that the socio-economic situation was driving both risk practices of NCDs and the availability of tobacco, alcohol and junk food.

The leverage point analysis indicated that the health sector should focus on the development of prevention systems for effective NCDs action. The leverages emphasised that the health system should step out of its traditional role and utilise systemic and collaborative approaches to intervene on social determinants i.e. the health system can play a pivotal role in leading and coordinating prevention of such risks and advocate for health in all policies across sectors. They also emphasised what policy and local actions could occur to make changes within the umbrella of robust prevention system. These included increasing tax on tobacco and alcohol products, strengthening

monitoring of sales of such products, curbing the accessibility of junk food, and strengthening the physical activity practices within communities. The health system could play a key role in coordinating with urban design for better systems design and communication sectors to prevent unethical marketing of junk food products.

For so long the health sectors in LMIC have only tried to emulate what HIC have been doing. HIC have exhausted huge resources for NCDs treatment and have gradually realized that that these curative focused approaches are least effective from a public health perspective. Such approaches to tackle NCDs in LMIC could be an absolute disaster for public health i.e. investing more in hospitals and curative care research. LMIC that already have limited resources at their disposal can learn from this failure and focus on prevention. Development of a robust localised prevention system based on the vision of primary health care approach could be the appropriate direction forward in tackling complex challenges like NCDs. The Ministry of Health could play a proactive role in guiding all sectors towards collective action to impacting social and commercial determinants of health based on primary health care approach.

References

1. World Health Organization. Global Status Report of NCD 2010. Geneva: World Health Organization. 2011.

2. Alleyne G, Binagwaho A, Haines A, Jahan S, Nugent R, Rojhani A, et al. Embedding non-communicable diseases in the post-2015 development agenda. The Lancet. 2013;381(9866):566-74.

3. World Health Organization. Global Status Report on noncommunicable diseases 2014. World Health Organization; 2014.

4. Bell R, Lutz B. Disscussion Paper: addressing the social determinants of non-communicable diseases. USA: UNDP; 2013.

5. Stuckler D, Siegel K. Sick societies: responding to the global challenge of chronic disease: OUP Oxford; 2011.

6. World Health Organization. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. 2013.

7. World Bank. Non-communicable diseases (NCDs)- Nepal's next major health challenge; 2011 [cited February 15 2016]. Available from: http://siteresources.worldbank.org/SOUTHASIAEXT/Resources/223546-1296680097256/7707437-1296680114157/NCD_NP_Policy_Feb_2011.pdf.

8. World Health Organization. Disease and injury country estimates: World Health Organization; 2016 [cited October 15 2016]. Available from: https://www.who.int/healthinfo/global_burden_disease/estimates/en/index1.html.

9. Bhandari G, Angdembe M, Dhimal M, Neupane S, Bhusal C. State of non-communicable diseases in Nepal. BMC public health. 2014;14(1):23.

10. Aryal KK, Neupane S, Mehata S, Singh S, Pulin F, Madanlal R, et al. Non-communicable diseases risk factors: STEPS Survey Nepal 2013. Kathmandu, Nepal: Ministry of Health, Nepal Health Research Council and World Health Organziation; 2014.

11. Ministry of Health. WHO STEPS Surveillance: Non-communicable diseases risk factors survey. Kathmandu, Nepal: Ministry of Health, Society for Local Integrated Development Nepal and World Health Organziation; 2008.

12. World health Organization. Noncommunicable diseases: key facts; 2016 [cited October 31 2016]. Available from: http://www.who.int/mediacentre/factsheets/fs355/en/.

13. Sharma SR, Page R, Matheson A, Lambrick D, Faulkner J, Mishra SR. Non-communicable disease prevention in Nepal: systemic challenges and future directions. Global health promotion. 2017:1757975917720800.

14. Marasini BR. Health and hospital development in Nepal: past and present. J Nep Med Assoc. 2003;42(149):306-11.

15. Dixit H. History of health professional education in Nepal. Journal of Kathmandu Medical College. 2017;6(4):161-6.

16. Dixit H. Nepal’s quest for health. Kathmandu, Nepal: Educational Publishing House. 2005.

17. Department of Health Services. Annual Report 2013/14. Kathmandu, Nepal; 2014.

18. Dawson P, Pradhan Y, Houston R, Karki S, Poudel D, Hodgins S. From research to national expansion: 20 years' experience of community-based management of childhood pneumonia in Nepal. Bulletin of the World Health Organization. 2008;86(5):339-43.

19. McPherson RA, Tamang J, Hodgins S, Pathak LR, Silwal RC, Baqui AH, et al. Process evaluation of a community-based intervention promoting multiple maternal and neonatal care practices in rural Nepal. BMC pregnancy and childbirth. 2010;10(1):31.

20. Sharma J, Aryal A, Thapa GK. Envisioning a high-quality health system in Nepal: if not now, when? The Lancet Global Health. 2018;6(11):e1146-e8.

21. Puska P. Non-communicable diseases—neglected diseases in global health work? The European Journal of Public Health. 2011;21(3):269-.

22. Nugent R, Feigl A. Where have all the donors gone? Scarce donor funding for non-communicable diseases. Center for Global Development Working Paper. 2010(228).

23. World Health Organization. United Nations high-level meeting on noncommunicable disease prevention and control: NCD summit to shape the international agenda: World Health Organization; 2011 [cited February 15 2016]. Available from: https://www.who.int/nmh/events/un_ncd_summit2011/en/.

24. World Health Organization. Rio Political Declaration on Social Determinants of Health, Rio de Janeiro, Brazil. 2011.

25. United Nations. Sustainable Development Goals 2015; 2015 [cited October 15 2016]. Available from: https://sustainabledevelopment.un.org/sdgs.

26. Popkin BM, Adair LS, Ng SW. NOW AND THEN: The Global Nutrition Transition: The Pandemic of Obesity in Developing Countries. Nutrition reviews. 2012;70(1):3-21.

27. Solar O, Irwin A. A conceptual framework for action on the social determinants of health. Geneva: World Health Organization; 2010.

28. World Health Organization. Health in 2015: from MDGs to SDGs Geneva; 2015 [cited October 20 2016]. Available from: http://www.who.int/gho/publications/mdgs-sdgs/en/.

29. NCD Alliance. Briefing paper: tackling non-communicable diseases to enhance sustainable development. London: NCD Alliance; 2012.

30. Government of Nepal. National Health Policy 2014. In: Government of Nepal, editor. Kathmandu, Nepal: Ministry of Health and Population; 2014.

31. Ministry of Health and Population. Nepal Health Sector Programme 2015-2020 (Unofficial translation). Kathmandu: Government of Nepal; 2015.

32. Government of Nepal. Multisectoral Action Plan for the Prevention and Control of Non-communicable diseases (2014-2020). In: Government of Nepal and World Health Organization, editor. Kathmandu, Nepal2010.

33. Neupane D, Kallestrup P. Non-communicable Diseases in Nepal: Challenges and Opportunities. Journal of Nepal Health Research Council. 2013;11(24):225-8.

34. Gautam R. NCDs in Nepal: Burgeoning Burden amid Low Priority and the Ways Forward. Health Prospect. 2012;11:iv-v.

35. Dhitali SM, Karki A, editors. Dealing with the burden of hypertension in Nepal: current status, challenges and health system issues. Regional Health Forum; 2013.

36. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. The lancet. 2013;380(9859):2224-60.

37. World Health Organization. A global brief on hypertension: silent killer, global public health crisis. World Health Organization; 2013.

38. Ludwig J, Sanbonmatsu L, Gennetian L, Adam E, Duncan GJ, Katz LF, et al. Neighborhoods, obesity, and diabetes—a randomized social experiment. New England Journal of Medicine. 2011;365(16):1509-19.

39. Aitsi-Selmi A, Chandola T, Friel S, Nouraei R, Shipley MJ, Marmot MG. Interaction between education and household wealth on the risk of obesity in women in Egypt. PloS one. 2012;7(6):e39507.

40. Ministry of Health and Population (MoHP) [Nepal], New ERA, ICF International Inc. Nepal Demographic and Health Survey 2011. Kathmandu, Nepal: Ministry of Health and Population (MoHP) [Nepal], New ERA and ICF International Inc.; 2011.

41. Sreeramareddy CT, Ramakrishnareddy N, Kumar H, Sathian B, Arokiasamy J. Prevalence, distribution and correlates of tobacco smoking and chewing in Nepal: a secondary data analysis of Nepal Demographic and Health Survey-2006. Subst Abuse Treat Prev Policy. 2011;6(33.10):1186.

42. Khanal V, Adhikari M, Karki S. Social determinants of tobacco consumption among Nepalese men: findings from Nepal Demographic and Health Survey 2011. Harm Reduct J. 2013;10:40.

43. Lindholm LH, Mendis S. Prevention of cardiovascular disease in developing countries. The Lancet. 2007;370(9589):720-2.

44. Blas E, Kurup AS. Equity, social determinants and public health programmes: World Health Organization; 2010.

45. World Health Organization. The World health report 2002: reducing risks, promoting healthy life. Switzerland: World Health Organization; 2002.

46. Sharma SR, Mishra SR, Wagle K, Page R, Matheson A, Lambrick D, et al. Social determinants of common metabolic risk factors (high blood pressure, high blood sugar, high body mass index and high waist-hip ratio) of major non-communicable diseases in South Asia region: a systematic review protocol. Syst Rev. 2017;6(1):183.

47. Marmot M, Bell R. Social determinants and non-communicable diseases: time for integrated action. Bmj. 2019;364:l251.

48. Global Health e-Learning Center. Governance and Health: USAID; 2015 [cited April 15 2016]. Available from: https://www.globalhealthlearning.org/program/governance-and-health.

49. Management Sciences for Health. Health Systems in Action: An eHandbook for Leaders and Managers. Cambridge, MA: Management Sciences for Health; 2010.

50. Aitken JM. Voices from the inside: managing district health services in Nepal. The International journal of health planning and management. 1994;9(4):309-40.

51. Mishra SR, Neupane D, Preen D, Kallestrup P, Perry HB. Mitigation of non-communicable diseases in developing countries with community health workers. Globalization and health. 2015;11(1):1.

52. Neupane D, Kallestrup P, McLachlan CS, Perry H. Community health workers for non-communicable diseases. The Lancet Global health. 2014;2(10):e567.

53. New ERA. An analytical report on female community health volunteers of selected districts of Nepal. Government of Nepal, New Era and USAID; 2008.

54. Gau Y-M, Buettner P, Usher K, Stewart L. Burden experienced by community health volunteers in Taiwan: a survey. BMC public health. 2013;13(1):1.

55. Glenton C, Scheel I, Pradhan S, Lewin S, Hodgins S, Shrestha V. The female community health volunteer programme in Nepal: decision makers' perceptions of volunteerism, payment and other incentives. Social science & medicine (1982). 2010;70(12):1920 - 7.

56. WHO Country Office for Nepal. Health system in Nepal: challenges and strategic options. Nepal: World Health Organization; 2007.

57. Kc N, Kc A, Sharma N, Malla H, Thapa N, Aryal K, et al. Community participation and mobilization in community-based maternal, newborn and child health programmes in Nepal. Journal of Nepal Health Research Council. 2011.

58. Gurung G, Derrett S, Hill PC, Gauld R. Governance challenges in the Nepalese primary health care system: time to focus on greater community engagement? The International journal of health planning and management. 2016;31(2):167-74.

59. Fleischer NL, Roux AVD, Alazraqui M, Spinelli H. Social patterning of chronic disease risk factors in a Latin American city. Journal of Urban Health. 2008;85(6):923-37.

60. Goyal A, Bhatt DL, Steg PG, Gersh BJ, Alberts MJ, Ohman EM, et al. Attained educational level and incident atherothrombotic events in low-and middle-income compared with high-income countries. Circulation. 2010;122(12):1167-75.

61. Rosengren A, Subramanian S, Islam S, Chow CK, Avezum A, Kazmi K, et al. Education and risk for acute myocardial infarction in 52 high, middle and low-income countries: INTERHEART case-control study. Heart. 2009;95(24):2014-22.

62. Bassanesi SL, Azambuja MI, Achutti A. Premature mortality due to cardiovascular disease and social inequalities in Porto Alegre: from evidence to action. Arquivos brasileiros de cardiologia. 2008;90(6):403-12.

63. Mackenbach JP, Stirbu I, Roskam A-JR, Schaap MM, Menvielle G, Leinsalu M, et al. Socioeconomic inequalities in health in 22 European countries. New England Journal of Medicine. 2008;358(23):2468-81.

64. Allen L, Williams J, Townsend N, Mikkelsen B, Roberts N, Foster C, et al. Socioeconomic status and non-communicable disease behavioural risk factors in low-income and lower-middle-income countries: a systematic review. Lancet Glob Health. 2017;5(3):e277-e89.

65. Kawachi I, Berkman LF. Social cohesion, social capital, and health. In: Berkman LF, Kawachi I, editors. Social epidemiology: Oxford University Press, Inc.; 2000. p. 174-90.

66. Kawachi I, Subramanian SV, Kim D. Social capital and health. New York: Springer; 2008.

67. Bennett L, Dahal DR, Govindasamy P. Caste, Ethnic and Regional Identity in Nepal: Further Analysis of the 2006 NDHS. Claverton, Maryland, USA; 2008.

68. Nepal Earthquake Case Studies: caste based inequality: Dartmouth; 2015 [cited May 15 2019]. Available from: https://journeys.dartmouth.edu/NepalQuake-CaseStudies/caste-based-inequality/

69. The World Bank, Department for International Development. Unequal citizens: gender, caste and ethnic exclusion in Nepal (Summary): The World Bank, Department for International Development; 2005.

70. Banstola A, Banstola A. The Epidemiology of Hospitalization for Pneumonia in Children under Five in the Rural Western Region of Nepal: A Descriptive Study. PloS one. 2013;8(8):e71311.

71. Mudacumura GM, Morçöl G. Challenges to democratic governance in developing countries: Springer; 2014.

72. Ministry of Health and Family Welfare. Organogram: Bangladesh; 2014 [cited April 15 2016]. Available from: http://www.mohfw.gov.bd/index.php?option=com_content&view=article&id=200&Itemid=85&lang=en.

73. Ministry of Health. New MoH Organogram Bhutan: Royal Government of Bhutan; 2015 [cited April 15 2016]. Available from: http://www.health.gov.bt/about/organogram/.

74. Ministry of Healthcare and Nutrition. Non-communicable disease unit: Sri Lanka; 2015 [cited April 15 2016]. Available from: http://www.health.gov.lk/en/NCD/index.php.

75. Ministry of Health. Organizational Structure Kenya: Ministry of Health: Kenya; 2015 [cited April 15 2016]. Available from: http://www.health.go.ke/?page_id=134.

76. Ministry of Health and Population. Budget analysis 2010/11. Kathmandu: Ministry of Health and Population and NHSSP; 2011.

77. Government of Nepal. Budget Speech of Fiscal Year 2015/16. Kathmandu; 2015.

78. Canavan CR, Jay J. Why NCD response needs universal health coverage. The Lancet Global Health Blog: The Lancet Global Health Journal; 2014 [cited April 15 2016]. Available from: http://globalhealth.thelancet.com/2014/09/15/why-ncd-response-needs-universal-health-coverage.

79. Marmot M, Allen J, Goldblatt P, Boyce T, McNeish D, Grady M, et al. The Marmot review: Fair society, healthy lives. The Strategic Review of Health Inequalities in England Post-2010. 2010.

80. National Advisory Committee. The social, cultural and economic determinants of health in New Zealand: Action to improve health. Wellington: National Advisory Committee. 1998.

81. Marmot M, Allen J, Bell R, Bloomer E, Goldblatt P. WHO European review of social determinants of health and the health divide. The lancet. 2012;380(9846):1011-29.

82. Ministry of Health. The New Zealand Health Strategy. New Zealand: Ministry of Health; 2000.

83. Lawless A, Williams C, Hurley C, Wildgoose D, Sawford A, Kickbusch I. Health in All Policies: evaluating the South Australian approach to intersectoral action for health. Canadian Journal of Public Health/Revue Canadienne de Sante'e Publique. 2012:S15-S9.

84. Pandey JP, Dhakal MR, Karki S, Poudel P, Pradham MS. Maternal and child health in Nepal: The effects of caste, ethnicity, and regional identity. Calverton, Maryland, USA: ICF International; 2013.

85. Bambra C, Fox D, Scott-Samuel A. Towards a politics of health. Health promotion international. 2005;20(2):187-93.

86. Kickbusch I. The political determinants of health—10 years on. Bmj. 2015;350.

87. Buse K, Mays N, Walt G. Making health policy: Open University Press; 2005.

88. Fafard P. Beyond the usual suspects: using political science to enhance public health policy making. Journal of epidemiology and community health. 2015:jech-2014-204608.

89. The Asia Foundation. Political economy analysis of local governance in Nepal with special reference to education and health sectors. Kathmandu: The Asia Foundation; 2012.

90. The Carter Center. Local Governance in Nepal: Public Participation and Perception. Kathmandu: The Carter Center; 2014.

91. The World Bank. Worldwide Governance Indicators; 2016 [cited July 12 2017]. Available from: http://databank.worldbank.org/data/reports.aspx?source=Worldwide-Governance-Indicators.

92. World Bank. Nepal- world development Indicators; 2014 [cited March 10 2016]. Available from: http://data.worldbank.org/country/nepal.

93. Department of Health Services. Annual Report 2010/11. Kathmandu, Nepal; 2011.

94. Ministry of Education. Education for all: National Plan of Action. Kathmandu: Ministry of Education; 2003.

95. Government of Nepal. Interim Constitution of Nepal. Kathmandu, Nepal: GoN; 2007.

96. Bonita R, Beaglehole R. Women and NCDs: overcoming the neglect. Global health action. 2014;7(1):23742.

97. Lundgren R, Beckman M, Chaurasiya SP, Subhedi B, Kerner B. Whose turn to do the dishes? Transforming gender attitudes and behaviours among very young adolescents in Nepal. Gender & Development. 2013;21(1):127-45.

98. Pokharel S. Gender discrimination: Women perspectives. Nepalese journal of development and rural studies. 2008;5(2):80-7.

99. Bhattarai HP. Cultural Diversity and Pluralism in Nepal: Emerging issues and the search for a new paradigm. Contributions to Nepalese Studies. 2004;31(2):293-340.

100. Pradhan R. Ethnicity, caste and a pluralist society. Perspectives on Modern South Asia: A Reader in Culture, History, and Representation. 2011;100.

101. Poudel D, Acharya B, Pant S, Poudel D, Pradhan Y. Developing, Piloting and Scaling-up of Nepal's Neonatal Care Program. Journal of Nepal Health Research Council. 2012;10(21):95.

102. Pradhan Y, Upreti S, Pratap KCN K, Khadka N, Syed U, Kinney M, et al. Newborn survival in Nepal: a decade of change and future implications. Health Policy Plan. 2012;27 Suppl 3:iii57 - 71.

103. Ministry of Health and Population. Health sector gender equality and social inclusion strategy. Kathmandu, Nepal: MoHP; 2009.

104. Ministry of Health and Population. Institutional Structure Establishment and Operational Guidelines for Gender Equality and Social Inclusion. Kathmandu, Nepal: MoHP; 2013.

105. Ministry of Health and Population. Operational Guidelines for Gender Equality and Social Inclusion Mainstreaming in the Health Sector. Kathmandu, Nepal: MoHP; 2013.

106. Ministry of Health and Population. National Safe Motherhood and Newborn Health Long Term Plan (2006-17). Kathmandu, Nepal: MoHP; 2006.

107. Ministry of Health and Population. Business plan of the health sector 2013/2014. Kathmandu, Nepal: MoHP; 2013.

108. Ministry of Health and Population. Nepal Health Sector Programme – Implementation Plan (NHSP – IP II): 2010-15. Kathmandu, Nepal: MoHP; 2010.

109. Pandey JP, Dhakal S, Karki S, Poudel P, Pradhan MS. Maternal and child health in Nepal: the effects of caste, ethnicity, and regional identity: further analysis of the 2011. Nepal demographic and health survey. Calverton, Maryland, USA: Nepal Ministry of Health and Population, New ERA, and ICF International; 2013.

110. RTI International. Equity analysis of health care utilization and outcomes in Nepal. Research Triangle Park, NC, USA: RTI International; 2008.

111. Pokharel RK, Houston R, Harvey P, Bishwakarma R, Adhikari J, Pant KD, et al. Nepal Nutrition Assessment and Gap Analysis (NAGA): Final report of Nutritional Assessment Team. In: Child Health Division DoHS, editor. Kathmandu: Ministry of Health and Population; 2009.

112. Adhikari SR, Maskay M, Sharma BP. Paying for hospital-based care of Kala-azar in Nepal: assessing catastrophic, impoverishment and economic consequences. Health policy and planning. 2009;24(2):129-39.

113. Pang T, Guindon GE. Globalization and risks to health. EMBO Reports. 2004;5(Suppl 1):S11-S6.

114. Cornia GA. Globalization and health: results and options. Bulletin of the World Health Organization. 2001;79(9):834-41.

115. Thow AM. Trade liberalisation and the nutrition transition: mapping the pathways for public health nutritionists. Public health nutrition. 2009;12(11):2150-8.

116. Legge D, Gleeson D, Snowdon W, Thow AM, editors. Trade Agreements and Non-communicable Diseases in the Pacific Islands. Pacific NCD Forum; 2011.

117. Snowdon W, Thow A. Trade policy and obesity prevention: challenges and innovation in the Pacific Islands. obesity reviews. 2013;14(S2):150-8.

118. Obesity Evidence Hub. Countries that have implemented taxes on sugar-sweetened beverages (SSBs) Australia: Cancer Council; 2020 [cited June 15 2020]. Available from: https://www.obesityevidencehub.org.au/collections/prevention/countries-that-have-implemented-taxes-on-sugar-sweetened-beverages-ssbs.

119. McLean R, Mann J. Tackling obesity: a call to action. The New Zealand medical journal. 2014;127(1406):6-9.

120. Stoner L, Matheson A, Hamlin M, Skidmore P. Environmental determinants of childhood obesity: a specific focus on Māori and Pasifika in New Zealand. Perspectives in public health. 2016;136(1):18-20.

121. Stoner L, Page R, Matheson A, Tarrant M, Stoner K, Rubin D, et al. The indigenous health gap: raising awareness and changing attitudes. Perspectives in Public Health. 2015;135(2):68-70.

122. Theodore R, McLean R, TeMorenga L. Challenges to addressing obesity for Māori in Aotearoa/New Zealand. Australian and New Zealand Journal of Public Health. 2015;39(6):509-12.

123. Centre for Disease Control. CDC-Adult Obesity facts; 2016 [cited June 20 2020]. Available from: http://www.cdc.gov/obesity/data/adult.html.

124. Weishaar H. The Tobacco Epidemic and the Commercial Sector: Tobacco Industry Strategies to Increase Profits and Prevent Regulation. In: Loddenkemper R, Kreuter M, editors. The Tobacco Epidemic 2015.

125. Moodie R, Stuckler D, Monteiro C, Sheron N, Neal B, Thamarangsi T, et al. Profits and pandemics: prevention of harmful effects of tobacco, alcohol, and ultra-processed food and drink industries. The Lancet. 2013;381(9867):670-9.

126. World Health Organization. About the WHO Framework Convention on Tobacco Control; 2015 [cited March 15 2016]. Available from: http://www.who.int/fctc/about/en/.

127. Ministry of Health and Family Welfare. National action plan and monitoring framework for prevention and control of noncommunicable disease (NCDs) in India. India: Government of India; 2013.

128. Ministry of Health. NCD Action Plan Brazil: 2011-2022. Brazil: Government of Brazil; 2011.

129. Ministry of Health. National Policy for the prevention and control of chronic non-communicable diseases in Ghana. Ghana: Government of Ghana; 2012.

130. Ministry of Healthcare and Nutrition. The national policy and strategic framework for prevention and control of chronic non-communicable diseases. Sri Lanka: Government of Sri Lanka; 2009.

131. Minsitry of Health. The New Zealand Health Strategy. New Zealand: Ministry of Health; 2000.

132. Ring IT, Firman D. Reducing indigenous mortality in Australia: lessons from other countries. The Medical Journal of Australia. 1998;169(10):528-9, 32-3.

133. Durie MH. Indigenous health: New Zealand experience. Medical Journal of Australia. 2012;197(1):10.

134. Ministry of Health. Whanau Ora programme; 2018 [cited June 15 2020]. Available from: https://www.health.govt.nz/our-work/populations/maori-health/whanau-ora-programme.

135. Ministry of Social Development. Frameworks for change in Family Violence (2019-2023); 2019 [cited June 15 2020]. Available from: https://www.msd.govt.nz/about-msd-

and-our-work/work-programmes/initiatives/family-and-sexual-violence/frameworks-for-change-in-family-violence.html.

136. Stokes E. The treaty of Waitangi and the Waitangi tribunal: Maori claims in New Zealand. Applied Geography. 1992;12(2):176-91.

137. Delany T, Lawless A, Baum F, Popay J, Jones L, McDermott D, et al. Health in All Policies in South Australia: what has supported early implementation? Health promotion international. 2015.

138. Smith JA, Crawford G, Signal L. The case of national health promotion policy in Australia: where to now? Health Promotion Journal of Australia. 2016;27(1):61-5.

139. Milstein B, Homer J, Briss P, Burton D, Pechacek T. Why behavioral and environmental interventions are needed to improve health at lower cost. Health affairs. 2011;30(5):823-32.

140. Organization for Economic Cooperation and Development. Aid to developing countries rebounds in 2013 to reach all time high: OECD; 2014 [cited March 18 2016]. Available from: http://www.oecd.org/newsroom/aid-to-developing-countries-rebounds-in-2013-to-reach-an-all-time-high.htm.

141. Moyo D. Dead aid: Why aid is not working and how there is a better way for Africa. United States: Farrar, Straus & Giroux Inc; 2009.

142. Mayhew SH. Donor dealings: the impact of international donor aid on sexual and reproductive health services. International Family Planning Perspectives. 2002;28(4):220-4.

143. Allen L. Why is there no funding for non-communicable diseases? Journal of Global Health Perspectives. 2016.

144. Allen L. Non-communicable disease funding. The Lancet Diabetes & Endocrinology. 2017;5(2):92.

145. Roux AD. Complex systems thinking and current impasses in health disparities research. American journal of public health. 2011;101(9):1627-34.

146. Finegood DT, Cawley J. The complex systems science of obesity. The Oxford handbook of the social science of obesity. New York: Oxford University Press; 2011. p. 208-36.

147. Homer JB, Hirsch GB. System dynamics modeling for public health: Background and opportunities. American journal of public health. 2006;96:452 - 8.

148. De Savigny D, Adam T. Systems thinking for health systems strengthening: World Health Organization; 2009.

149. Matheson A. Reducing social inequalities in obesity: complexity and power relationships. Journal of Public Health. 2016.

150. Green LW. Public Health Asks of Systems Science: To Advance Our Evidence-Based Practice, Can You Help Us Get More Practice-Based Evidence? American journal of public health. 2006;96(3):406-9.

151. Adam T, de Savigny D. Systems thinking for strengthening health systems in LMICs: need for a paradigm shift. Health Policy and Planning. 2012;27(suppl 4):iv1-iv3.

152. Sterman JD. Business dynamics: Systems thinking and modeling for a complex world. Boston: Irwin/McGraw-Hill; 2000.

153. Luke DA, Stamatakis KA. Systems science methods in public health: Dynamics, networks, and agents. Annual review of public health. 2012;33:357 - 76.

154. Atkinson J, Wells R, Page A, Dominello A, Haines M, Wilson A. Applications of system dynamics modelling to support health policy. Public Health Research Practice. 2015;25:e2531531.

155. Vandenbroeck P, Goossens J, Clemens M. Foresight, Tackling Obesities: Future Choices–Building the Obesity System Map. London: Government Office for Science. 2007.

156. National Cancer Institute. Greater than the sum: Systems thinking in tobacco control. Tobacco Control Monograph No. 18. Bethesda, MD: US Department of Health and Human Services, National Institutes of Health, National Cancer Institute; 2007.

157. Milstein B, Homer J, Hirsch G. Analyzing national health reform strategies with a dynamic simulation model. American journal of public health. 2010;100(5):811.

158. Rwashana AS, Williams DW, Neema S. System dynamics approach to immunization healthcare issues in developing countries: a case study of Uganda. Health Informatics Journal. 2009;15(2):95-107.

159. Rwashana Semwanga A, Nakubulwa S, Nakakeeto-Kijjambu M, Adam T. Advancing the application of systems thinking in health: understanding the dynamics of neonatal mortality in Uganda. Health research policy and systems / BioMed Central. 2014;12.

160. Kothari CR. Research methodology: Methods and techniques. India: New Age International; 2004.

161. Midgley G. Systemic intervention: philosophy, methodology and practice. New York: Kluwer Academic/Plenum Publishers; 2000.

162. Midgley G. Systemic Intervention for Public Health. American journal of public health. 2006;96(3):466-72.

163. Yin RK. Case study research: Design and methods: Sage publications; 2013.

164. Midgley G. What is this thing called CST? Critical systems thinking: Springer; 1996. p. 11-24.

165. Minkler M, Wallerstein N. Community-based participatory research for health: From process to outcomes: John Wiley & Sons; 2010.

166. Müller-Böker U. Spatial organization of a caste society: the example of the Newar in the Kathmandu Valley, Nepal. Mountain Research and Development. 1988:23-31.

167. Chamber of Industries. District Profile- Morang; 2017 [cited August 10 2017]. Available from: https://www.cim.org.np/district.php.

168. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. Administration and Policy in Mental Health and Mental Health Services Research. 2015;42(5):533-44.

169. Smith J, Firth J. Qualitative data analysis: the framework approach. Nurse researcher. 2011;18(2):52-62.

170. Dedoose® Software. Version 7 ed. USA: SocioCultural Research Consultants, LLC; 2016.

171. Excel®. Office 365: Microsoft; 2016.

172. Vensim® Software. Version 7.1 ed. USA: Ventana Systems Inc.; 2015.

173. Meadows DH. Places to Intervene in a System. Whole Earth. 1997;91:78-84.

174. Meadows DH. Thinking in systems: A primer. White River Junction, VT: Chelsea Green; 2008.

175. Abson DJ, Fischer J, Leventon J, Newig J, Schomerus T, Vilsmaier U, et al. Leverage points for sustainability transformation. Ambio. 2017;46(1):30-9.

176. John Hopkins University. Systems Thinking in Public Health: Coursera; 2016 [cited March 8 2016]. Available from: https://www.coursera.org/learn/systems-thinking/home/welcome.

177. Beauchamp TL, Childress JF. Principles of biomedical ethics: Oxford University Press, USA; 2001.

178. Mishra SR, Neupane D, Bhandari PM, Khanal V, Kallestrup P. Burgeoning burden of non-communicable diseases in Nepal: a scoping review. Globalization and health. 2015;11(1):32.

179. Aryal KK, Mehata S, Neupane S, Vaidya A, Dhimal M, Dhakal P, et al. The Burden and Determinants of Non Communicable Diseases Risk Factors in Nepal: Findings from a Nationwide STEPS Survey. PloS one. 2015;10(8):e0134834.

180. Ministry of Health (Nepal), New ERA, ICF. Nepal Demographic and Health Survey 2016. Kathmandu, Nepal: Ministry of Health, Nepal; 2017.

181. Sharma S, Pandey S, Pathak D, Sijapati-Basnett B. State of migration in Nepal: Centre for the Study of Labour and Mobility Kathmandu; 2014.

182. Tripathy JP, Thakur JS, Jeet G, Chawla S, Jain S, Prasad R. Urban rural differences in diet, physical activity and obesity in India: are we witnessing the great Indian equalisation? Results from a cross-sectional STEPS survey. BMC public health. 2016;16(1):816.

183. Khanal V, Adhikari M, Karki S. Social determinants of tobacco consumption among Nepalese men: findings from Nepal Demographic and Health Survey 2011. Harm reduction journal. 2013;10(1):40.

184. Dhital R. Alcohol and young people in Nepal. The Globe. 2001;4:21-5.

185. RECPHEC. Rapid assessment on media coverage of junk food and its content analysis on selected Nepali and Indian Television Channels. Kathmandu, Nepal: Resource Centre for Primary Health Care (RECPHEC); 2013.

186. Binu V, Subba S, Menezes R, Kumar G, Ninan J, Rana M, et al. Smoking among Nepali youth–prevalence and predictors. Asian Pacific journal of cancer prevention : APJCP. 2010;11(1):221-6.

187. Prasad R. Alcohol use on the rise in India. The Lancet. 2009;373(9657):17-8.

188. BK AB. The Stigma of the Name: Making and Remaking of Dalit Identity in Nepal. Kathmandu, Nepal: Social Science Baha; 2013.

189. Saito E, Gilmour S, Yoneoka D, Gautam GS, Rahman MM, Shrestha PK, et al. Inequality and inequity in healthcare utilization in urban Nepal: a cross-sectional observational study. Health policy and planning. 2016;31(7):817-24.

190. Mehata S, Paudel YR, Dariang M, Aryal KK, Lal BK, Khanal MN, et al. Trends and inequalities in use of maternal health care services in Nepal: strategy in the search for improvements. BioMed research international. 2017.

191. Uchtenhagen A. Substance use problems in developing countries. SciELO Public Health; 2004.

192. World Health Organization. Tobacco and poverty: a vicious circle. Switzerland: World Health Organization; 2004.

193. Musinguzi G, Anthierens S, Nuwaha F, Van Geertruyden J-P, Wanyenze RK, Bastiaens H. Factors Influencing Compliance and Health Seeking Behaviour for Hypertension in Mukono and Buikwe in Uganda: A Qualitative Study. International journal of hypertension. 2018.

194. Mohanty SK, Agrawal NK, Mahapatra B, Choudhury D, Tuladhar S, Holmgren EV. Multidimensional poverty and catastrophic health spending in the mountainous regions of Myanmar, Nepal and India. International journal for equity in health. 2017;16(1):21.

195. Brunson J. Confronting maternal mortality, controlling birth in Nepal: The gendered politics of receiving biomedical care at birth. Social Science & Medicine. 2010;71(10):1719-27.

196. Paudel M, Javanparast S, Dasvarma G, Newman L. A qualitative study about the gendered experiences of motherhood and perinatal mortality in mountain villages of Nepal: implications for improving perinatal survival. BMC Pregnancy and Childbirth. 2018;18:163.

197. Fikree FF, Pasha O. Role of gender in health disparity: the South Asian context. BMJ : British Medical Journal. 2004;328(7443):823-6.

198. Hatlebakk M. Son preference, number of children, education and occupational choice in rural Nepal. Review of Development Economics. 2017;21(1):1-20.

199. Nanda P, Gautam MA, Verma R, Hong KT, Linh MTG, Puri M, et al. Study on gender, masculinity and son preference in Nepal and Vietnam. New Delhi: International Center for Research on Women. 2012.

200. Mishra P. Socioeconomic and political status of women in Nepal. Kathmandu, Nepal: National Women Comission, Shantimalika; 2013.

201. Luitel S. The social world of Nepalese Women. Occas Pap Physiol Anthropol. 2008:PP 100-12.

202. Acharya DR, Bell JS, Simkhada P, Van Teijlingen ER, Regmi PR. Women's autonomy in household decision-making: a demographic study in Nepal. Reproductive health. 2010;7(1):15.

203. Ministry of Health and Population (MoHP) [Nepal], New ERA, Macro International Inc. . Nepal Demographic and Health Survey 2006. Kathmandu, Nepal; 2007.

204. Yusuf S, Hawken S, Ôunpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. The Lancet. 2004;364(9438):937-52.

205. Muriwai E, Huckle T, Romeo J. Māori attitudes and behaviours towards alcohol: Wellington: Health Promotion Agency; 2018.

206. Intergovernmental Committee on Drugs. National Aboriginal and Torres Strait Islander Peoples' Drug Strategy 2014 - 2019: A sub-strategy of the National Drug Strategy 2010 - 2015. Australia: Intergovernmental Committee on Drugs; 2014.

207. Department of the Prime Minister and Cabinet. Closing the gap report 2019. Australia: Commonwealth of Australia, Department of the Prime Minister and Cabinet; 2019.

208. Eades SJ, Chamberlain C. Seeking a comprehensive approach to tobacco control for Aboriginal and Torres Strait Islander people. The Medical Journal of Australia. 2015;202(10):511-2.

209. Hatsukami DK, Stead LF, Gupta PC. Tobacco addiction. The Lancet. 2008;371(9629):2027-38.

210. Benowitz N. Clinical pharmacology of nicotine: implications for understanding, preventing, and treating tobacco addiction. Clinical Pharmacology & Therapeutics. 2008;83(4):531-41.

211. Shakya DR. Alcohol abuse in eastern Nepal: a review of studies. Health Renaissance. 2013;11(1):74-82.

212. Arora M, Tewari A, Tripathy V, Nazar GP, Juneja NS, Ramakrishnan L, et al. Community-based model for preventing tobacco use among disadvantaged adolescents in urban slums of India. Health promotion international. 2010;25(2):143-52.

213. Mackinnon N, Bhatia U, Nadkarni A. The onset and progression of alcohol use disorders: A qualitative study from Goa, India. J Ethn Subst Abuse. 2017:1-14.

214. Ziervogel CF, Ahmed N, Flisher AJ, Robertson BA. Alcohol misuse in South african male adolescents: a qualitative investigation. International quarterly of community health education. 1997;17(1):25-41.

215. Prabhu P, Srinivas R, Vishwanathan K, Raavi A. Factors influencing alcohol and tobacco addiction among patients attending a de-addiction Centre, South India. Journal of International Society of Preventive & Community Dentistry. 2014;4(2):103-7.

216. Bhaskar RK, Sah MN, Gaurav K, Bhaskar SC, Singh R, Yadav MK, et al. Prevalence and correlates of tobacco use among adolescents in the schools of Kalaiya, Nepal: a cross-sectional questionnaire based study. Tobacco Induced Diseases. 2016;14(1):11.

217. Scales MB, Monahan JL, Rhodes N, Roskos-Ewoldsen D, Johnson-Turbes A. Adolescents' perceptions of smoking and stress reduction. Health Education & Behavior. 2009;36(4):746-58.

218. Jones L, Sumnall H. Understanding the relationship between poverty and alcohol misuse. Liverpool: Liverpool John Moores University. 2016:9-17.

219. Keyes KM, Hatzenbuehler ML, Hasin DS. Stressful life experiences, alcohol consumption, and alcohol use disorders: the epidemiologic evidence for four main types of stressors. Psychopharmacology (Berl). 2011;218(1):1-17.

220. Stubbs B, Veronese N, Vancampfort D, Prina AM, Lin P-Y, Tseng P-T, et al. Perceived stress and smoking across 41 countries: A global perspective across Europe, Africa, Asia and the Americas. Scientific Reports. 2017;7(1):7597.

221. Parrott AC. Does cigarette smoking cause stress? American Psychologist. 1999;54(10):817.

222. Kassel JD, Stroud LR, Paronis CA. Smoking, stress, and negative affect: correlation, causation, and context across stages of smoking. Psychological bulletin. 2003;129(2):270.

223. Parajuli VJ, Macdonald S, Jimba M. Social–Contextual Factors Associated with Alcohol Use among Adolescents of Traditional Alcohol User and Nonuser Ethnic Groups of Nepal. Journal of Ethnicity in Substance Abuse. 2015;14(2):151-65.

224. Dhital R, Subedi G, Gurung Y, Hamal P. Alcohol and Drug Use in Nepal (with reference to children). Kathmandu: Child Workers in Nepal Concerned Centre (CWIN); 2001.

225. Wolf PA, D'Agostino RB, Kannel WB, Bonita R, Belanger AJ. Cigarette smoking as a risk factor for stroke: The framingham study. JAMA. 1988;259(7):1025-9.

226. Ling PM, Glantz SA. Why and how the tobacco industry sells cigarettes to young adults: evidence from industry documents. American journal of public health. 2002;92(6):908-16.

227. Lee S, Ling PM, Glantz SA. The vector of the tobacco epidemic: tobacco industry practices in low and middle-income countries. Cancer Causes & Control. 2012;23(1):117-29.

228. Warner KE. The economics of tobacco: myths and realities. Tobacco control. 2000;9(1):78-89.

229. Heart Foundation. Resources New Zealand: Heart Foundation, NZ; 2016 [cited March 10 2016]. Available from: https://www.heartfoundation.org.nz/resources/.

230. Heart Foundation. Your heart Australia: Heart Foundation, AU; 2016 [cited March 10 2016]. Available from: https://heartfoundation.org.au/support/health-information-service.

231. Thankappan KR. Tobacco cessation in India: A priority health intervention. The Indian journal of medical research. 2014;139(4):484-6.

232. Abdullah ASM, Husten CG. Promotion of smoking cessation in developing countries: a framework for urgent public health interventions. Thorax. 2004;59(7):623.

233. Nguyen N, Nguyen T, Chapman J, Nguyen L, Kumar P, VanDevanter N, et al. Tobacco cessation in Vietnam: Exploring the role of village health workers. Global public health. 2017:1-11.

234. Lando HA. Promoting Tobacco Cessation in Low- and Middle-Income Countries. Journal of Smoking Cessation. 2016;11(2):66-9.

235. Kaur J, Jain D. Tobacco Control Policies in India: Implementation and Challenges. Indian journal of public health. 2011;55(3):220-7.

236. World Health Organization. Noncommunicable diseases progress monitor 2015. 2015.

237. World Health Organization Regional Office for Africa. The WHO Framework Convention on Tobacco Control: 10 years of implementation in the African Region. Brazzaville, Republic of Congo: WHO Regional Office for Africa; 2015.

238. Studlar DT. The Political Dynamics of Tobacco Control in Australia and New Zealand: Explaining Policy Problems, Instruments, and Patterns of Adoption. Australian Journal of Political Science. 2005;40(2):255-74.

239. National Cancer Institute and World Health Organization. The Economics of Tobacco and Tobacco Control. Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute; and Geneva, CH: World Health Organization; 2016.

240. Ahmad B, Fouad FM, Elias M, Zaman S, Phillimore P, Maziak W. Health system challenges for the management of cardiovascular disease and diabetes: an empirical qualitative study from Syria. International journal of public health. 2015;60(1):55-62.

241. Willis-Shattuck M, Bidwell P, Thomas S, Wyness L, Blaauw D, Ditlopo P. Motivation and retention of health workers in developing countries: a systematic review. BMC health services research. 2008;8(1):247.

242. Marten R, McIntyre D, Travassos C, Shishkin S, Longde W, Reddy S, et al. An assessment of progress towards universal health coverage in Brazil, Russia, India, China, and South Africa (BRICS). The Lancet. 2014;384(9960):2164-71.

243. Kickbusch I, McCann W, Sherbon T. Adelaide revisited: from healthy public policy to Health in All Policies. Health promotion international. 2008;23(1):1-4.

244. Singh A, Ladusingh L. Prevalence and Determinants of Tobacco Use in India: Evidence from Recent Global Adult Tobacco Survey Data. PloS one. 2014;9(12):e114073.

245. Sreeramareddy CT, Pradhan PMS, Mir IA, Sin S. Smoking and smokeless tobacco use in nine South and Southeast Asian countries: prevalence estimates and social determinants from Demographic and Health Surveys. Population Health Metrics. 2014;12(1):22.

246. John RM, Ross H, Blecher E. Tobacco expenditure and its implications for household resource allocation in Cambodia. Tobacco Control. 2012;21(3):341.

247. Chowdhury AN, Ramakrishna J, Chakraborty AK, Weiss MG. Cultural context and impact of alcohol use in the Sundarban Delta, West Bengal, India. Social Science & Medicine. 2006;63(3):722-31.

248. Gaunekar G, Patel V, Rane A. The impact and patterns of hazardous drinking amongst male industrial workers in Goa, India. Social Psychiatry and PsychiatricEpidemiology. 2005;40(4):267-75.

249. Mohindra KS, Narayana D, Anushreedha SS, Haddad S. Alcohol use and its consequences in South India: Views from a marginalised tribal population. Drug and alcohol dependence. 2011;117(1):70-3.

250. Aklimunnessa K, Khan MMH, Kabir M, Mori M. Prevalence and correlates of domestic violence by husbands against wives in Bangladesh: evidence from a national survey. The Journal of Men's Health & Gender. 2007;4(1):52-63.

251. Mao A, Bristow K, Robinson J. Caught in a dilemma: why do non-smoking women in China support the smoking behaviors of men in their families? Health education research. 2013;28(1):153-64.

252. Ackerson LK, Kawachi I, Barbeau EM, Subramanian SV. Exposure to domestic violence associated with adult smoking in India: a population based study. Tobacco Control. 2007;16(6):378.

253. Mackay J, Amos A. Women and tobacco. Respirology. 2003;8(2):123-30.

254. Saxena S, Sharma RAJ, Maulik PK. Impact of alcohol use on poor families: a study from North India. Journal of Substance Use. 2003;8(2):78-84.

255. Efroymson D, Ahmed S, Townsend J, Alam SM, Dey AR, Saha R, et al. Hungry for tobacco: an analysis of the economic impact of tobacco consumption on the poor in Bangladesh. Tobacco Control. 2001;10(3):212.

256. Maharjan P, Magar K. Prevalence of Alcohol Consumption and Factors Associated with the Alcohol Use among the Youth of Suryabinayak Municipality, Bhaktapur. J Pharma Care Health Sys. 2017;4(168).

257. Odgers CL, Caspi A, Nagin DS, Piquero AR, Slutske WS, Milne BJ, et al. Is it important to prevent early exposure to drugs and alcohol among adolescents? Psychological science. 2008;19(10):1037-44.

258. Gellner DN. Caste, ethnicity and inequality in Nepal. Economic and Political Weekly. 2007:1823-8.

259. Kim DH. Systems archetypes I: diagnosing systemic issues and designing high-leverage interventions: Pegasus Communications; 1993.

260. Lounsbury DW, Mitchell SG. Introduction to special issue on social ecological approaches to community health research and action. American Journal of Community Psychology. 2009;44(3-4):213-20.

261. Lachat C, Otchere S, Roberfroid D, Abdulai A, Seret FMA, Milesevic J, et al. Diet and Physical Activity for the Prevention of Noncommunicable Diseases in Low- and Middle-Income Countries: A Systematic Policy Review. PLOS Medicine. 2013;10(6):e1001465.

262. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Impact of Physical Inactivity on the World's Major Non-Communicable Diseases. Lancet. 2012;380(9838):219-29.

263. Dhungana RR, Bista B, Pandey AR, de Courten M. Prevalence, clustering and sociodemographic distributions of non-communicable disease risk factors in Nepalese adolescents: secondary analysis of a nationwide school survey. BMJ open. 2019;9(5):e028263.

264. Kohl HW, 3rd, Craig CL, Lambert EV, Inoue S, Alkandari JR, Leetongin G, et al. The pandemic of physical inactivity: global action for public health. The Lancet.380(9838):294-305.

265. Graham H, White PCL. Social determinants and lifestyles: integrating environmental and public health perspectives. Public health. 2016;141:270-8.

266. The Lancet Oncology. Two days in New York: reflections on the UN NCD summit. The Lancet Oncology.12(11):981.

267. Donkin A, Goldblatt P, Allen J, Nathanson V, Marmot M. Global action on the social determinants of health. BMJ global health. 2017;3(Suppl 1):e000603-e.

268. Ball K, Carver A, Downing K, Jackson M, O'Rourke K. Addressing the social determinants of inequities in physical activity and sedentary behaviours. Health promotion international. 2015;30(suppl_2):ii8-ii19.

269. Fortune K, de Snyder NS, Galvão LAC, Murphy M. The Social Determinants of NCDs. Economic Dimensions of Noncommunicable Diseases in Latin America and the Caribbean. 2016:31.

270. Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U. Global physical activity levels: surveillance progress, pitfalls, and prospects. The Lancet. 2012;380(9838):247-57.

271. Das P, Horton R. Physical activity- time to take it seriously and regularly. The Lancet. 2016;388(10051):1254-5.

272. Department of Health Services. Annual Report 2015/16. Kathmandu, Nepal: Ministry of Health; 2016.

273. Department of Health and Family Welfare. Annual Report 2015/16. India: Ministry of Health and Family Welfare; 2016.

274. Medical Statistics Unit. Annual Health Bulletin. India: Ministry of Health, Nutrition and Indigenous Medicine; 2015.

275. Horton R. Offline: NCDs - why are we failing? The Lancet.390(10092):346.

276. Reis RS, Salvo D, Ogilvie D, Lambert EV, Goenka S, Brownson RC, et al. Scaling up physical activity interventions worldwide: stepping up to larger and smarter approaches to get people moving. The lancet. 2016;388(10051):1337-48.

277. Sallis JF, Cerin E, Conway TL, Adams MA, Frank LD, Pratt M, et al. Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study. The Lancet.387(10034):2207-17.

278. Balarajan Y, Selvaraj S, Subramanian SV. Health care and equity in India. The Lancet. 2011;377(9764):505-15.

279. Bonita R, Magnusson R, Bovet P, Zhao D, Malta DC, Geneau R, et al. Country actions to meet UN commitments on non-communicable diseases: a stepwise approach. The Lancet. 2013;381(9866):575-84.

280. Beaglehole R, Ebrahim S, Reddy S, Voûte J, Leeder S. Prevention of chronic diseases: a call to action. The Lancet. 2008;370(9605):2152-7.

281. Misra A, Singhal N, Khurana L. Obesity, the metabolic syndrome, and type 2 diabetes in developing countries: role of dietary fats and oils. Journal of the American College of Nutrition. 2010;29(3 Suppl):289s-301s.

282. Pradeepa R, Anjana RM, Joshi SR, Bhansali A, Deepa M, Joshi PP, et al. Prevalence of generalized & abdominal obesity in urban & rural India- the ICMR - INDIAB Study (Phase-I) [ICMR - INDIAB-3]. The Indian journal of medical research. 2015;142(2):139-50.

283. Vaidya A, Shakya S, Krettek A. Obesity Prevalence in Nepal: Public Health Challenges in a Low-Income Nation during an Alarming Worldwide Trend. International journal of environmental research and public health. 2010;7(6):2726-44.

284. Ramachandran A, Snehalatha C. Rising burden of obesity in Asia. Journal of Obesity. 2010.

285. Waqanivalu TK. Pacific islanders pay heavy price for abandoning traditional diet. Bulletin of the World Health Organization. 2010;88(7):484-5.

286. Kolahdooz F, Sheikholeslam R, Naghavi M, Abdollahi Z. Junk food consumption: an indicator of changing dietary habit in Iranian children. Asia Pacific journal of clinical nutrition. 2004;13.

287. Hassan Wassef H. Food habits of the Egyptians: newly emerging trends. EMHJ - Eastern Mediterranean Health Journal. 2004;10(6),898-915.

288. Jacobs A, Richtel M. How big business got Brazil hooked on junk food. New York Times, Sept. 2017;16:2017.

289. Stuckler D, Nestle M. Big Food, Food Systems, and Global Health. PLOS Medicine. 2012;9(6):e1001242.

290. Sadeghirad B, Duhaney T, Motaghipisheh S, Campbell NRC, Johnston BC. Influence of unhealthy food and beverage marketing on children's dietary intake and preference: a systematic review and meta-analysis of randomized trials. Obesity Reviews. 2016;17(10):945-59.

291. Dixon HG, Scully ML, Wakefield MA, White VM, Crawford DA. The effects of television advertisements for junk food versus nutritious food on children's food attitudes and preferences. Social Science & Medicine. 2007;65(7):1311-23.

292. Hastings G, McDermott L, Angus K, Stead M, Thomson S. The extent, nature and effects of food promotion to children: a review of the evidence. Geneva: World Health Organization. 2006;20.

293. Nestle M. Food politics: How the food industry influences nutrition and health: Univ of California Press; 2013.

294. Jolly R. Marketing Obesity? Junk Food, Advertising and Kids: Research Paper no. 9 2010-11. Australia: Parliamentary Library, Parliament of Australia; 2011.

295. Magnusson RS. Obesity prevention and personal responsibility: the case of front-of-pack food labelling in Australia. BMC public health. 2010;10(1):662.

296. Anjana RM, Pradeepa R, Das AK, Deepa M, Bhansali A, Joshi SR, et al. Physical activity and inactivity patterns in India – results from the ICMR-INDIAB study (Phase-1) [ICMR-INDIAB-5]. The international journal of behavioral nutrition and physical activity. 2014;11:26-.

297. Moniruzzaman M, Zaman MM, Islalm M, Ahasan H, Kabir H, Yasmin R. Physical activity levels in Bangladeshi adults: results from STEPS survey 2010. Public health. 2016;137:131-8.

298. Ng N, Hakimi M, Van Minh H, Juvekar S, Razzaque A, Ashraf A, et al. Prevalence of physical inactivity in nine rural INDEPTH Health and Demographic Surveillance Systems in five Asian countries. Global health action. 2009;2(1):1985.

299. Kimokoti RW, Fung TT, Millen BE. Chapter 7 - Dietary Patterns/Diet and Health of Adults in Economically Developing Countries. Bioactive Food as Dietary Interventions for the Aging Population. San Diego: Academic Press; 2013. p. 83-107.

300. Pou SA, del Pilar Díaz M, De La Quintana AG, Forte CA, Aballay LR. Identification of dietary patterns in urban population of Argentina: study on diet-obesity relation in population-based prevalence study. Nutrition Research and Practice. 2016;10(6):616-22.

301. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. American journal of health promotion. 1997;12(1):38-48.

302. Scharff RL. Obesity and hyperbolic discounting: Evidence and implications. Journal of Consumer Policy. 2009;32(1):3-21.

303. Lawton J, Ahmad N, Hanna L, Douglas M, Hallowell N. 'I can't do any serious exercise': barriers to physical activity amongst people of Pakistani and Indian origin with Type 2 diabetes. Health education research. 2006;21(1):43-54.

304. Harvard Health Publishing. An Introduction to Yoga. Harvard Medical School; 2016.

305. Bishwajit G. Nutrition transition in South Asia: the emergence of non-communicable chronic diseases. F1000Research. 2015;4:8.

306. World Bank. Data: Agriculture, forestry, and fishing, value added (% of GDP); 2018 [cited March 18 2019]. Available from: https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS.

307. Bishwajit G. Household wealth status and overweight and obesity among adult women in Bangladesh and Nepal. Obesity science & practice. 2017;3(2):185-92.

308. Balarajan Y, Villamor E. Nationally representative surveys show recent increases in the prevalence of overweight and obesity among women of reproductive age in Bangladesh, Nepal, and India. The Journal of nutrition. 2009;139(11):2139-44.

309. Hallal PC, Matsudo SM, Matsudo VKR, Araújo TL, Andrade DR, Bertoldi AD. Physical activity in adults from two Brazilian areas: similarities and differences. Cadernos de saude publica. 2005;21:573-80.

310. Knuth AG, Bacchieri G, Victora CG, Hallal PC. Changes in physical activity among Brazilian adults over a 5-year period. J Epidemiol Community Health. 2010;64(7):591-5.

311. Singh A, Purohit B. Physical activity, sedentary lifestyle, and obesity among Indian dental professionals. Journal of Physical Activity and Health. 2012;9(4):563-70.

312. Keeley B, Wright L, Condit CM. Functions of health fatalism: fatalistic talk as face saving, uncertainty management, stress relief and sense making. Sociology of health & illness. 2009;31(5):734-47.

313. World Health Organization. Noncommunicable Diseases; 2018 [cited November 10 2018]. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.

314. Signal LN, Walton MD, Ni Mhurchu C, Maddison R, Bowers SG, Carter KN, et al. Tackling 'wicked' health promotion problems: a New Zealand case study. Health promotion international. 2012;28(1):84-94.

315. Khamis A-a. Overcoming the health system challenges in the 21st century and beyond? Public health. 2019;168:47-9.

316. Nugent R, Bertram MY, Jan S, Niessen LW, Sassi F, Jamison DT, et al. Investing in non-communicable disease prevention and management to advance the Sustainable Development Goals. The Lancet. 2018;391(10134):2029-35.

317. Niessen LW, Mohan D, Akuoku JK, Mirelman AJ, Ahmed S, Koehlmoos TP, et al. Tackling socioeconomic inequalities and non-communicable diseases in low-income and middle-income countries under the Sustainable Development agenda. The Lancet. 2018;391(10134):2036-46.

318. Horton R, Sargent J. 2018 must be the year for action against NCDs. The Lancet. 2018;391(10134):1971-3.

319. Samb B, Desai N, Nishtar S, Mendis S, Bekedam H, Wright A, et al. Prevention and management of chronic disease: a litmus test for health-systems strengthening in low-income and middle-income countries. The Lancet. 2010;376(9754):1785-97.

320. Maher D, Ford N, Unwin N. Priorities for developing countries in the global response to non-communicable diseases. Globalization and health. 2012;8(1):14.

321. World Health Organization. Noncommunicable diseases: progress monitor 2017. 2017. Report No.: 9241513020.

322. Dhakal R, Ratanawijitrasin S, Srithamrongsawat S. Addressing the challenges to health sector decentralization in Nepal: an inquiry into the policy and implementation processes. Nepal Medical College journal : NMCJ. 2009;11(3):152-7.

323. Mondal S, Van Belle S. India's NCD strategy in the SDG era: are there early signs of a paradigm shift? Globalization and health. 2018;14(1):39.

324. Miranda JJ, Kinra S, Casas JP, Davey Smith G, Ebrahim S. Non-communicable diseases in low- and middle-income countries: context, determinants and health policy. Tropical medicine & international health : TM & IH. 2008;13(10):1225-34.

325. Department of Health Services. Annual Report 2017/18. Kathmandu, Nepal: Ministry of Health; 2018.

326. Sanders D, Reynolds L. The Politics of Primary Health Care. Oxford University Press; 2019.

327. Shaikh BT, Hatcher J. Health seeking behaviour and health service utilization in Pakistan: challenging the policy makers. Journal of public health. 2004;27(1):49-54.

328. Chaudhury N, Hammer J, Kremer M, Muralidharan K, Rogers FH. Missing in action: teacher and health worker absence in developing countries. Journal of Economic perspectives. 2006;20(1):91-116.

329. Van Lerberghe W. The world health report 2008: primary health care: now more than ever: World Health Organization; 2008.

330. Matheson A, Walton M, Gray R, Wehipeihana N, Wistow J. Strengthening prevention in communities through systems change: Lessons from the evaluation of Healthy Families NZ. Health promotion international. 2019.

331. Sims J, Aboelata MJ. A System of Prevention: Applying a Systems Approach to Public Health. Health promotion practice. 2019;20(4):476-82.

332. Sharma V, Ortiz MR. A holistic approach to redefining Nepal's health-care system. The Lancet Global Health. 2019;7(3):e305.

333. Faltermaier T. Why public health research needs qualitative approaches: subjects and methods in change. The European Journal of Public Health. 1997;7(4):357-63.

334. Baum F. Researching public health: behind the qualitative-quantitative methodological debate. Social science & medicine. 1995;40(4):459-68.

335. Kaur M. Application of Mixed Method Approach in Public Health Research. Indian journal of community medicine : official publication of Indian Association of Preventive & Social Medicine. 2016;41(2):93-7.

336. Tolley EE, Ulin PR, Mack N, Robinson ET, Succop SM. Qualitative methods in public health: a field guide for applied research: John Wiley & Sons; 2016.

337. Isaacs AN. An overview of qualitative research methodology for public health researchers. International journal of medicine and public health. 2014;4(4).

338. Bonell C, Moore G, Warren E, Moore L. Are randomised controlled trials positivist? Reviewing the social science and philosophy literature to assess positivist tendencies of trials of social interventions in public health and health services. Trials. 2018;19(1):238.

339. Krieger N. Theories for social epidemiology in the 21st century: an ecosocial perspective. International journal of epidemiology. 2001;30(4):668-77.

340. Jackson MC, Sambo LG. Health systems research and critical systems thinking: the case for partnership. Systems Research and Behavioral Science. 2020;37(1):3-22.

341. Bonita R, Winkelmann R, Douglas KA, de Courten M. The WHO Stepwise approach to surveillance (STEPS) of non-communicable disease risk factors. Global behavioral risk factor surveillance: Springer; 2003. p. 9-22.

342. Sharma SR, Matheson A. Systems thinking in 21st century: a call to health promoters. Health Prospect: Journal of Public Health. 2016;15(2):1-2.

343. Murray S. Poverty and health. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne. 2006;174(7):923-.

344. World Health Organisation. NCDs, poverty and development; 2019 [cited September 22 2019]. Available from: https://www.who.int/global-coordination-mechanism/ncd-themes/poverty-development/en/.

345. Pillay-van Wyk V, Bradshaw D. Mortality and socioeconomic status: the vicious cycle between poverty and ill health. The Lancet Global Health. 2017;5(9):e851-e2.

346. Levasseur P. Can social programs break the vicious cycle between poverty and obesity? Evidence from urban Mexico. World Development. 2019;113:143-56.

347. Mishra SR, Ghimire S, Joshi C, Gyawali B, Shrestha A, Neupane D, et al. Cardio-metabolic disease risk factors among South Asian labour migrants to the Middle East: a scoping review and policy analysis. Globalization and health. 2019;15(1):33.

348. Donini A. Social suffering and structural violence: Nepali workers in Qatar. The ILO@ 100: Brill Nijhoff; 2019. p. 178-99.

349. Aryal BK, Daud M, Thapa A, Mahotra A, Magar SA, Malla CK. Assesssment of health facilities for implementation of package of essential non-communicable disease in Nepal: baseline study in Kailali and Ilam District. Journal of Nepal Health Research Council. 2018;16(2):149-55.

350. Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, et al. Priority actions for the non-communicable disease crisis. The Lancet. 2011;377(9775):1438-47.

351. Beaglehole R, Bonita R, Alleyne G, Horton R, Li L, Lincoln P, et al. UN high-level meeting on non-communicable diseases: addressing four questions. The Lancet. 2011;378(9789):449-55.

352. The Lancet. Non-communicable diseases series: Elsevier; 2013 [cited 10 October 2015]. Available from: http://www.thelancet.com/series/non-communicable-diseases.

353. Leppo K, Ollila E, Peña S, Wismar M, Cook S. Health in all policies: seizing opportunities, implementing policies. European Observatory of Health Systems and Policies. 2014.

354. Chand PB, Kharel R. Politics of Primary Health Care in Nepal. Health for all: the journey of Universal Health Coverage Hyderabad (IN): BMJ Publishing Group. 2015.

355. Rasanathan K, Montesinos EV, Matheson D, Etienne C, Evans T. Primary health care and the social determinants of health: essential and complementary approaches for reducing inequities in health. Journal of Epidemiology & Community Health. 2011;65(8):656-60.

356. Karkee R, Jha N. Primary health care development: where is Nepal after 30 years of Alma Ata Declaration? Journal of the Nepal Medical Association. 2010;49(178).

357. Fineberg HV. The paradox of disease prevention: celebrated in principle, resisted in practice. JAMA. 2013;310(1):85-90.

358. Marmot M, Friel S, Bell R, Houweling TA, Taylor S. Closing the gap in a generation: health equity through action on the social determinants of health. The Lancet. 2008;372(9650):1661-9.

359. de Andrade LOM, Filho AP, Solar O, Rígoli F, de Salazar LM, Serrate PC-F, et al. Social determinants of health, universal health coverage, and sustainable development: case studies from Latin American countries. The Lancet. 2015;385(9975):1343-51.

360. Taylor LA, Tan AX, Coyle CE, Ndumele C, Rogan E, Canavan M, et al. Leveraging the social determinants of health: what works? PloS one. 2016;11(8):e0160217.

361. McDaid D, Sassi F, Merkur S. Promoting Health, Preventing Disease: The Economic Case. World Health Organisation; 2015.

362. Mishra SR, Khanal P, Dhimal M. Nepal's quest for Universal Health Coverage. Journal of Pharmacy Practice and Community Medicine. 2016;2(4):104-6.

363. Dahal G. Constitution of Nepal and Political Development: Adaption and Challenges of Implication. Janapriya Journal of Interdisciplinary Studies. 2017;6:148-59.

364. Gupta AK, Adhikari SH, Shrestha GL. Corruption in Nepal: Level, Pattern and Trend Analysis. Journal of Management and Development Studies. 2018;28:36-52.

365. Martini M. Corruption and governance indicators in selected Asian countries: U4 Expert Answer. Norway: U4 Anti-Corruption Resource Centre, Transparency International and CHR. Michelsen Institute; 2016.

366. Sharma SP. Politics and corruption mar health care in Nepal. The Lancet. 2010;375(9731):2063-4.

367. Mishra SR, Khanal P, Karki DK, Kallestrup P, Enemark U. National health insurance policy in Nepal: challenges for implementation. Global health action. 2015;8(1):28763.

368. Health Promotion Agency. Health Promotion Agency Te Hiringa Hauora. 2018 [cited August 15 2019]. Available from: https://www.hpa.org.nz/.

369. Centre for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP). 2018 [cited August 15 2019]. Available from: https://www.cdc.gov/chronicdisease/index.htm.

370. Te Morenga L, Pekepo C, Corrigan C, Matoe L, Mules R, Goodwin D, et al. Co-designing an mHealth tool in the New Zealand Māori community with a "Kaupapa Māori" approach. AlterNative: An International Journal of Indigenous Peoples. 2018;14(1):90-9.

371. Sarkar D, Walker-Swaney J, Shetty K. Food Diversity and Indigenous Food Systems to Combat Diet-Linked Chronic Diseases. Current Developments in Nutrition. 2019;4(Supplement_1):3-11.

372. Adhikari L, Hussain A, Rasul G. Tapping the Potential of Neglected and Underutilized Food Crops for Sustainable Nutrition Security in the Mountains of Pakistan and Nepal. Sustainability. 2017;9(2):291.

373. Harmayani E, Anal AK, Wichienchot S, Bhat R, Gardjito M, Santoso U, et al. Healthy food traditions of Asia: exploratory case studies from Indonesia, Thailand, Malaysia, and Nepal. Journal of Ethnic Foods. 2019;6(1):1.

374. Khadka R, Paudel B, Sharma V, Kumar S, Bhattacharya N. Effect of yoga on cardiovascular autonomic reactivity in essential hypertensive patients. Health Renaissance. 2010;8(2):102-9.

375. Kuhnlein H, Eme P, de Larrinoa YF. 7 Indigenous Food Systems: Contributions to Sustainable Food Systems and Sustainable Diets. Sustainable Diets: Linking Nutrition and Food Systems. 2018:64.

376. Verbiest MEA, Corrigan C, Dalhousie S, Firestone R, Funaki T, Goodwin D, et al. Using codesign to develop a culturally tailored, behavior change mHealth intervention for indigenous and other priority communities: A case study in New Zealand. Translational behavioral medicine. 2018;9(4):720-36.

377. Boulton A, Kingi TK. Reflections on the Use of a Māori Conceptual Framework to Evaluate Complex Health Policy: The Case of New Zealand's Healthy Eating, Healthy Action Strategy Evaluation. Evaluation Journal of Australasia. 2011;11(1):5-10.

378. Hamerton H, Mercer C, Riini D, Mcpherson B, Morrison L. Evaluating Māori community initiatives to promote Healthy Eating, Healthy Action. Health promotion international. 2012;29(1):60-9.

379. Burlingame B, Vogliano C, Eme PE. Chapter Five - Leveraging agricultural biodiversity for sustainable diets, highlighting Pacific Small Island Developing States. In: Barling D, Fanzo J, editors. Advances in Food Security and Sustainability. 4: Elsevier; 2019. p. 133-73.

380. Chapman S, Wakefield M. Tobacco control advocacy in Australia: reflections on 30 years of progress. Health Education & Behavior. 2001;28(3):274-89.

381. Marten R, Kadandale S, Butler J, Aguayo VM, Axelrod S, Banatvala N, et al. Sugar, tobacco, and alcohol taxes to achieve the SDGs. The Lancet. 2018;391(10138):2400-1.

382. Thompson B, Molina Y, Viswanath K, Warnecke R, Prelip ML. Strategies To Empower Communities To Reduce Health Disparities. Health affairs (Project Hope). 2016;35(8):1424-8.

383. Wolff T, Minkler M, Wolfe SM, Berkowitz B, Bowen L, Butterfoss FD, et al. Collaborating for equity and justice: Moving beyond collective impact. Nonprofit Quarterly. 2017;9:42-53.

384. Fujihira H, Parkinson J, Rundle-Thiele S. Co-Designing Active Workplace Social Marketing Campaign: Barriers and Motivators to Sit Less and Stand Up: An Abstract. In: Krey N, Rossi P, editors. Back to the Future: Using Marketing Basics to Provide Customer Value. Cham: Academy of Marketing Science Annual Conference and Springer; 2017.

385. Roussy V, Riley T, Livingstone C, Russell G. A system dynamic perspective of stop–start prevention interventions in Australia. Health promotion international. 2019.

386. Glanz K, Rimer BK, Viswanath K. Health Behavior and Health Education: Theory, Research and Practice. 4 ed. USA: Jossey-Bass; 2008.

387. Maller CJ. Understanding health through social practices: performance and materiality in everyday life. Sociology of Health & Illness. 2015;37(1):52-66.

388. Shove E. Beyond the ABC: climate change policy and theories of social change. Environment and planning A. 2010;42(6):1273-85.

389. Kelly MP, Barker M. Why is changing health-related behaviour so difficult? Public health. 2016;136:109-16.

390. Coyle G. Qualitative and Quantitative Modelling in System Dynamics: Some Research Questions. System Dynamics Review. 2000;16:225-44.

391. Loewenberg S. Cuba's focus on preventive medicine pays off. The Lancet. 2016;387(10016):327-9.

392. Jackson MC. Critical Systems Thinking and the Management of Complexity. Oxford: Wiley; 2019.

Appendices

Appendix I:	Additional research outputs
Appendix II:	Study tools
Appendix III:	Interview and FGD participant's profile
Appendix IV:	Causal loop diagramming guidelines
Appendix V:	Sense-making workshops participants' lists
Appendix VI:	Ethics letters
Appendix VII:	Information Sheets
Appendix VIII:	Consent Forms
Appendix IX:	Glossary of Key terms
Appendix X:	Statements of contributions (DRC 16 Forms)

Appendix I: Additional research outputs

Commentary

Non-communicable disease prevention in Nepal: systemic challenges and future directions

Sudesh Raj Sharma[1,2], Rachel Page[2], Anna Matheson[2], Danielle Lambrick[3], James Faulkner[4] and Shiva Raj Mishra[1]

Abstract: Developing countries such as Nepal are experiencing a double burden of communicable and non-communicable diseases (NCDs) resulting in social and economic losses. In Nepal, more than half of the disease burden is due to NCDs. The major NCDs in Nepal are cardiovascular diseases, cancers, chronic respiratory diseases and diabetes. Behavioural factors such as tobacco use, alcohol consumption, physical inactivity and unhealthy diet are driving the epidemic of NCDs, which are further influenced by social, economic and environmental determinants. The health system of Nepal has not been able to address the ever-increasing burden of NCDs. With the formulation of the Multisectoral Action Plan for Prevention and Control of NCDs 2014–2020, there has been some hope for tackling the NCDs and their social determinants in Nepal through a primary prevention approach. This paper discusses the systemic challenges and recommends two key actions for the prevention and control of NCDs in Nepal.

Keywords: Non-communicable diseases, health promotion, challenges, opportunities

Background

Developing countries such as Nepal are experiencing an unprecedented burden of non-communicable diseases (NCDs) (1), with NCDs attributing 60% of disease burden in Nepal (2). The major metabolic/biological risk factors driving the NCD epidemic include clinical hypertension, elevated blood glucose and abnormal blood lipids (3–5). These metabolic risk factors are amplified by interaction with broader social determinants (behavioural, environmental and socio-political factors) disproportionately affecting the poor and vulnerable in developing countries (5–7). In this commentary, we highlight systemic challenges for addressing NCDs through primary prevention in Nepal especially in the light of Nepal's recent related policy and programmatic efforts. We further recommend that Nepal could accelerate preventive action against NCDs and their social determinants through two key actions: structural reform at policy level for coordinated actions and strengthening community-based health care delivery at implementation level.

Systemic challenges for NCD prevention in Nepal

Within the health system, curative services have gained more priority than prevention with increasing budgetary provisions in hospitals, patient care and development of clinical human resources (8). Though the provision of limited partial funding to the poor and destitute from public accounts for treatment of limited NCDs, namely cancer, kidney disease, heart disease, Parkinson's and Alzheimer's disease and head and spinal injuries (9) is commendable, it is not helping the urgent need for

1. Nepal Development Society, Chitwan, Nepal.
2. College of Health, Massey University, Wellington, New Zealand.
3. University of Southampton, Southampton, United Kingdom.
4. University of Winchester, Winchester, United Kingdom.

Correspondence to: Sudesh Raj Sharma, Massey University - College of Health, Mt Cook Wellington, Wellington 4442, New Zealand. Email: yoursudesh@gmail.com

Global Health Promotion 1757-9759; Vol 0(0): 1–4; 720800 DOI: 10.1177/1757975917720800 journals.sagepub.com/home/ghp

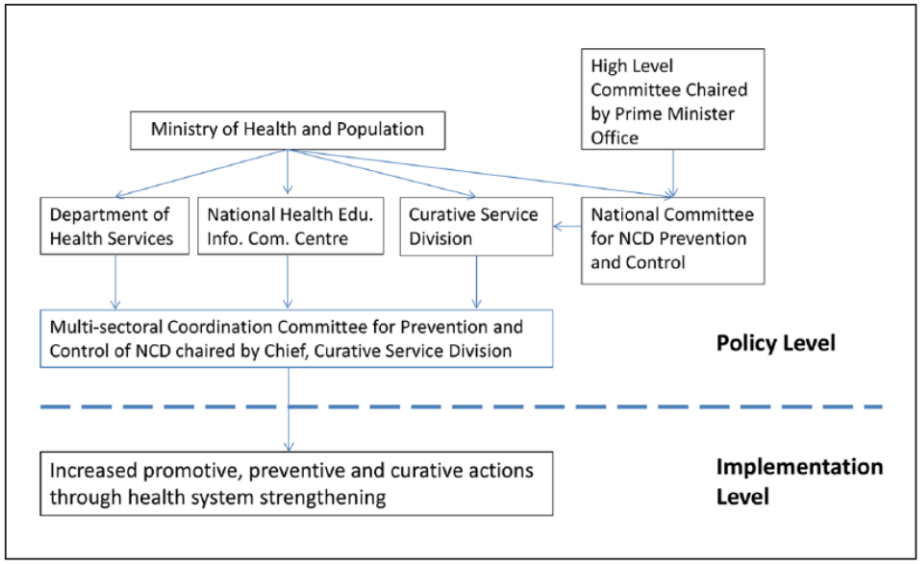


Figure 1. Policy structure envisaged by the MAPPCN 2014–2020.

shifting the focus towards primary prevention approach. Importantly, one of the key NCD policies, the *Multisectoral Action Plan for Prevention and Control of NCDs (MAPPCN) 2014–2020*, failed to set up a functional and compelling policy structure for accelerated action against NCDs and their social determinants (Figure 1) (10). The Curative Services Division, a division within the Ministry of Health with a primary role for improving curative services in public hospitals, is proposed as the main coordinating body for NCD prevention. This raises questions about whether the system is still in the grip of a medical model paradigm where the system considers NCDs as something to be addressed by a curative services agenda (tertiary prevention) and diverts funding needed for primary prevention of NCDs in Nepal.

Without an appropriate system structure for primary prevention of NCDs, significant policy-level momentum, including tobacco control initiatives, is losing ground under the current structure, which is already suffering some early setbacks (11–13). Any efforts on NCD prevention are further constrained by budget limitations and scarcity of human resources. The existing community health workers are of limited scope in NCD prevention and control unless adequately trained. In 2016, the government initiated the Prevention of Essential Non-Communicable Disease programmes in two districts of Nepal, but again the question will remain how effectively the programme will coordinate with other sectors to address the broader social determinants. In addition, lack of accountability, corruption and poor management are major causes of inefficiency in health and social sectors (14). This also poses threats to future NCD programmes. In a country which spends less than one percent of its budget on NCDs (15), inefficiency, as much as 40% estimated by WHO (16), can deter significant investment from prevention and control efforts.

Future direction of NCD prevention and health promotion

The NCD epidemic in Nepal demands a paradigm shift from a medical model to a primary prevention model focusing on social determinants of NCDs. Countries in the South are already leading the way (17–22). South–North collaboration and technology transfer can help low and middle-income countries like Nepal to build up capacity to prevent, control and monitor NCDs. We recommend that Nepal should establish an autonomous 'Centre' as the key structural reform for effective multisectoral and coordinated actions for NCD prevention and control (Figure 2). A powerful

b

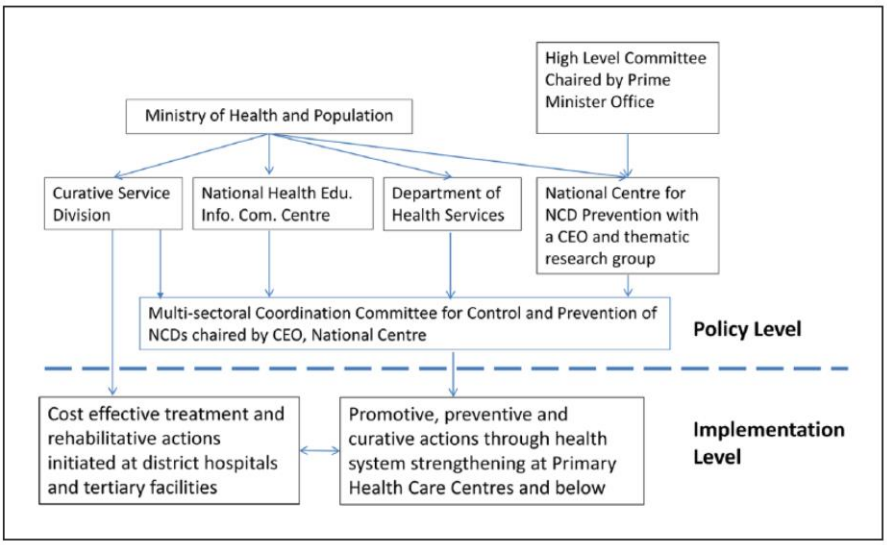


Figure 2. Recommended policy structure for NCD prevention in Nepal.

centre is essential to capitalize on the growing recognition of the NCD agenda at the policy level (23,24). The key social determinants of NCDs in addition to the traditional targets proposed in global monitoring frameworks (25*25 targets) can be incorporated into the existing Health Management Information System which is being revisited.

Our second recommendation is simultaneous strengthening of the community-based healthcare delivery system for accelerating a community-based NCD response. District health system reforms in the areas of quality of care, logistics supply, human resource training and overall management are the basic pre-requisites for the effective implementation of community-based actions. Nepal has experience in implementing community-based maternal and child health promotion programmes where strong leadership, a community-based approach and the support of external development partners have significantly contributed to the reduction in maternal and child mortality (25,26). Nepal should also tap the growing interest in NCDs among students and professionals. A national centre on NCDs is thus needed for balancing preventive and curative focuses, strengthening local health systems and harnessing collaboration among stakeholders for action on the social determinants of NCDs.

Authors' Contributions

SRS conceived and drafted the initial manuscript. RP, AM, JF, DL and SRM all critically reviewed and revised the initial manuscript. SRS and SRM prepared the final manuscript. All authors read and approved the final manuscript.

Acknowledgements

We would like to acknowledge Mr. Resham Khatri from Save the Children Nepal for his critical review and suggestions on the manuscript.

Conflict of interest

The authors declare that there is no conflict of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

1. World Health Organization. Global Status Report of NCD 2010. Geneva: World Health Organization; 2011.
2. World Bank. Non-communicable diseases (NCDs)-Nepal's next major health challenge. 2011. Available from: http://siteresources.worldbank.org/SOUTHASIAEXT/Resources/223546-1296680097256/7707437-1296680114157/NCD_NP_Policy_Feb_2011.pdf

3. Prospective Studies Collaboration. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. Lancet. 2002; 360: 1903–1913.
4. Emberson JR, Whincup PH, Morris RW, Walker M. Re-assessing the contribution of serum total cholesterol, blood pressure and cigarette smoking to the aetiology of coronary heart disease: Impact of regression dilution bias. Eur Heart J. 2003; 24: 1719–1726.
5. World Health Organization. The World Health Report 2002: Reducing Risks, Promoting Healthy Life. Geneva: World Health Organization; 2002.
6. Ibrahim MM, Damasceno A. Hypertension in developing countries. Lancet. 2012; 380: 611.
7. Bell R, Lutz B. Disscussion Paper: Addressing the Social Determinants of Non-Communicable Diseases. USA: UNDP; 2013.
8. Ministry of Finance. Budget Speech 2071/72 Nepal Kathmandu: Government of Nepal, 2015. Available from: http://mof.gov.np/uploads/cmsfiles/file/budget%20speech%202071–72_20140713125927.pdf.
9. Department of Health Services. Annual Report 2013/14. Kathmandu, Nepal: Department of Health Services; 2014.
10. Government of Nepal. Multisectoral Action Plan for the Prevention and Control of Non-communicable diseases (2014–2020). In: Government of Nepal and World Health Organization, editor. Kathmandu, Nepal; 2010.
11. Banstola A, Banstola A. BMJ Blogs [Internet]. Freeman B, editor: BMJ Publishing Groups Ltd. 2015. [cited 2015]. Available from: http://blogs.bmj.com/tc/2015/08/05/point-of-sale-display-a-call-to-action-on-prohibition-of-tobacco-products-in-nepal/?q=w_tc_blog_sidetab.
12. Himalayan News Service. Call for banning sale of tobacco products. Himalayan Times. 2015.
13. Republica. Stakeholders demand high tobacco tax. Republica. 2014.
14. The Asia Foundation. Political economy analysis of local governance in Nepal with special reference to education and health sectors. Kathmandu: The Asia Foundation; 2012.
15. Canavan CR, Jay J. The Lancet Global Health Blog [Internet]: The Lancet Global Health Journal. 2014. Available from: http://globalhealth.thelancet.com/2014/09/15/why-ncd-response-needs-universal-health-coverage.
16. World Health Organization. The World Health Report 2010: Health Systems Financing: The Path to Universal Coverage. Geneva: WHO; 2010. Report No.: 1020–3311.
17. The Lancet. Non-communicable diseases series: Elsevier; 2013 [cited 10 October 2015]. Available from: http://www.thelancet.com/series/non-communicable-diseases.
18. Leppo K, Ollila E, Peña S, Wismar M, Cook S. Health in all policies: seizing opportunities, implementing policies. European Observatory of Health Systems Policies; 2014.
19. Solar O, Irwin A. A Conceptual Framework for Action on the Social Determinants of Health. Geneva: World Health Organization; 2010.
20. Ministry of Health. The New Zealand Health Strategy. New Zealand: Ministry of Health; 2000.
21. Lawless A, Williams C, Hurley C, Wildgoose D, Sawford A, Kickbusch I. Health in all policies: evaluating the South Australian approach to intersectoral action for health. Can J Public Health. 2012; 103: eS15–S9.
22. Hospedales CJ, Barcelo A, Luciani S, Legetic B, Ordunez P, Blanco A. NCD prevention and control in Latin America and the Caribbean: a regional approach to policy and program development. Glob Heart. 2012; 7: 73–81.
23. Ministry of Health. Nepal Health Sector Programme 2015–2020 (Unofficial translation). Kathmandu: Government of Nepal; 2015.
24. Government of Nepal. National Health Policy 2014 (Nepal). In: Government of Nepal, editor. Kathmandu, Nepal: Ministry of Health and Population; 2014.
25. Dawson P, Pradhan Y, Houston R, Karki S, Poudel D, Hodgins S. From research to national expansion: 20 years' experience of community-based management of childhood pneumonia in Nepal. Bull World Health Organ. 2008; 86: 339–343.
26. McPherson RA, Tamang J, Hodgins S, Pathak LR, Silwal RC, Baqui AH, et al. Process evaluation of a community-based intervention promoting multiple maternal and neonatal care practices in rural Nepal. BMC Pregnancy Childbirth. 2010; 10: 31.

d

Editorial

Open Access: Full Text Article

Systems thinking in 21st century: a call to health promoters

Sudesh Raj Sharma[1*], Anna Matheson[1]
[1]College of Health, Massey University, Wellington

Received:
16 February 2016
Revised:
25 May 2016
Accepted:
28 June 2016

***Correspondence:**
yoursudesh@gmail.com
College of Health, Massey University, Wellington.

Health Promotion often deals with complex issues that are multi-factorial and multi-level such as malnutrition, maternal mortality and non-communicable diseases. In theory, health promotion boasts of using ecological and holistic approaches to improving public health but in practice, health promotion is dominated by the medical model (linear causal view) (1, 2) despite repeated calls for a more comprehensive approach (3, 4). Approaches to health promotion based on the medical model have merits but their sustainability and benefits to human development have time and again been questioned (2, 5, 6). For example, there have been significant achievements in the reduction of mortality for mothers, newborns and children in developing countries due to simple technological interventions (7, 8). However, at the same time, the problem of non-communicable disease is growing rapidly (9). Further, underlying root causes of public health problems such as poverty, access to quality health services and the empowerment of women remain unresolved. The lack of progress in addressing the root cause of complex health problems indicates that our existing approaches are failing and needs an alternative way of thinking. Systems science based thinking could provide appropriate scientific foundation for health promotion discipline to address complex health problems and its root causes (10, 11). In this short essay, we will explain why health promotion, as a discipline needs to bring system science perspective to deal with the multitude of health problems that developed and developing countries are facing alike.

First, let us understand what a complex system is and how systems thinking can be applied to it. A system is a congregation of the elements or structure which are interlinked with each other exhibiting an emergent behaviour over time (12). So, basically a system has three main aspects: structure, behaviour and interconnections. A complex system is composed of multiple elements operating at multiple levels with multiple interconnections and multiple emergent behaviours (13). Some key attributes of complex system include that they are self-organizing, dynamic, non-linear, governed by feedback, history-dependent and resistant to change (14). Social systems can be considered a complex system of human interrelationship with multiple structures interacting and influencing each other resulting in certain way of behaviour (13, 15-17).

A systems view sees public health problems like non-communicable diseases, maternal and newborn mortality and malnutrition as an undesirable behaviour being generated from the interaction and functioning of social system structures (10, 16). System thinking can be utilized both to understand the complex public health problems like NCD and identify strategies to mitigate the undesirable behaviour by actions on interconnections and structure. In the discipline of health promotion, the chorus is getting louder for utilising "systems science" due to the alignment of the epistemological and methodological stances of health promotion (11). Epistemologically, system science recognises the dynamic, non-linear and reflexive behaviour of social systems and takes a relativistic, subjective and critical viewpoint towards establishing a truth. This is consistent with health promotion discipline which emphasize on participatory and empowering approach (thus value-laden) to health improvement in a complex social setting. Methodologically, system science emphasizes mixed-method approaches to better understand the complexity of an issue. This also sits comfortably with the transdisciplinary nature of health promotion discipline. Common systems science methods applied in the public health field include agent based modelling, network analysis and system dynamics (18). They utilize the mixed-method approach for the synthesis and analysis of causal factors. One prominent systems thinker, in particular, has emphasized methodological pluralism in order to understand the complex dynamics of public health problems within a context (19). System thinkers should not be bounded by limited methods but continually strive to utilize multi-disciplinary approaches to understand complex reality. For example, system dynamics method (primarily a quantitative approach) is often combined with qualitative research strategies for improving research design and scientific reasoning of complex issues (20-22).

Systems thinking is proving to be a promising approach to understanding and dealing with complex public health problems where interactions are key (23, 24). Just like the popular story of "Five blind men and the perception of the elephant's body" where there is need for a comprehensive approach like systems thinking that could connect the incorrect mental models of each of the blind men and assist in developing a holistic shape of the elephant that reflects the reality. World Health Organization has developed the

"Social Determinants of Health" framework which elucidates the complexities involved in addressing health equity (25). Similarly, the popular "Ecological model" of health promotion also describes the complexities of health promotion actions (26). These frameworks and others present a broad range of factors associated with complex public health problems. However, there is suggestion that these frameworks may be improved upon and allow greater contextualization through identifying gaps in practice, and enable better design of effective interventions if a complex systems approach is applied (27). Systems methods and tools are better suited for illuminating the dynamic structure and emergent behaviour leading to complex health problems.

In Nepal as well as globally, health promotion (and public health) have been late in adopting the approaches and reaping the benefits of systems science (10). Itis high time that the health promoters embraced this innovative set of approaches in our research and practice which is well integrated within the management and other social science field (28-31). Some key complex health challenges that could be on this agenda include non-communicable diseases and risk factors prevention, maternal and child health promotion, health system strengthening and health policy analysis. Particularly in non-communicable disease prevention, systems thinking could be an effective approach for health promoters to tackle the actions of the corporate giants (mainly tobacco, alcohol and fast-food industries) who are already using systems approach for their gains and health promotion's loss (32, 33).

References

1. Cueto M. The ORIGINS of Primary Health Care and SELECTIVE Primary Health Care. American journal of public health. 2004;94(11):1864-1874.
2. McCoy D, Kembhavi G, Patel J, Luintel A. The Bill & Melinda Gates Foundation's grant-making programme for global health. The Lancet. 2009;373(9675):1645-1653.
3. World Health Organization. Milestones in health promotion: Statements from global conferences. Geneva: World Health Organization; 2009.
4. UNICEF, World Health Organization. Primary health care: report of the International Conference on Primary Health Care, Alma-Ata, USSR, 6-12 September 1978. 1978.
5. Beaglehole R, Bonita R. Public health at the crossroads: achievements and prospects. Cambridge University Press; 2004.
6. Werner D, Sanders D. The demise of primary health care and the rise of the child survival revolution In: The politics of primary health care and child survival. Palo Alto (CA). Health Wrights. 1997:23-30.
7. Darmstadt GL, Bhutta ZA, Cousens S, Adam T, Walker N, de Bernis L. Evidence-based, cost-effective interventions: how many newborn babies can we save? Lancet. 2005;365.
8. UNICEF. Committing to Child Survival: a Promise Renewed-Progress Report. United Nations Children's Fund (UNICEF); 2014.
9. World Health Organization. Global Status Report on noncommunicable diseases 2014. World Health Organization;2014.
10. Green LW. Public Health Asks of Systems Science: To Advance Our Evidence-Based Practice, Can You Help Us Get More Practice-Based Evidence? American journal of public health. 2006;96(3):406-409.
11. Tremblay M-C, Richard L. Complexity: a potential paradigm for a health promotion discipline. Health promotion international. 2014;29(2):378-388.
12. Meadows DH. Thinking in systems: A primer. White River Junction, VT: Chelsea Green; 2008.
13. Roux AVD. Integrating social and biologic factors in health research: a systems view. Annals of epidemiology. 2007;17(7):569-574.
14. De Savigny D, Adam T. Systems thinking for health systems strengthening. World Health Organization; 2009.
15. Sterman JD. Business dynamics: Systems thinking and modeling for a complex world. Boston: Irwin/McGraw-Hill; 2000.
16. Luke DA, Stamatakis KA. Systems science methods in public health: Dynamics, networks, and agents. Annual review of public health. 2012;33:357 - 376.
17. Sawyer RK. Social emergence: Societies as complex systems. Cambridge University Press; 2005.
18. Luke DA, Stamatakis KA. Systems science methods in public health: dynamics, networks, and agents. Annual review of public health. 2012;33:357.
19. Midgley G. Systemic Intervention for Public Health. American journal of public health. 2006;96(3):466-472.
20. Rwashana AS, Williams DW, Neema S. System dynamics approach to immunization healthcare issues in developing countries: a case study of Uganda. Health informatics journal. 2009;15(2):95-107.
21. Vandenbroeck P, Goossens J, Clemens M. Foresight, Tackling Obesities: Future Choices–Building the Obesity System Map. London: Government Office for Science. 2007.
22. Merrill JA, Deegan M, Wilson RV, Kaushal R, Fredericks K. A system dynamics evaluation model: implementation of health information exchange for public health reporting. Journal of the American Medical Informatics Association. 2013;20(e1):e131-e138.
23. Finegood DT, Cawley J. The complex systems science of obesity. The Oxford handbook of the social science of obesity. New York: Oxford University Press; 2011:208-236.
24. Homer JB, Hirsch GB. System dynamics modeling for public health: Background and opportunities. American journal of public health. 2006;96:452 - 458.
25. Solar O, Irwin A. A conceptual framework for action on the social determinants of health. World Health Organization;2007.
26. Sallis JF, Owen N, Fisher EB. Ecological models of health behavior. Health behavior and health education: Theory, research, and practice. 2008;4:465-486.
27. Matheson A. Reducing social inequalities in obesity: complexity and power relationships. Journal of Public Health. 2016.
28. Mabry PL, Milstein B, Abraido-Lanza AF, Livingood WC, Allegrante JP. Opening a window on systems science research in health promotion and public health. Health Education & Behavior. 2013;40(1 suppl):5S-8S.
29. Midgley G. Systemic intervention: philosophy, methodology and practice. New York: Kluwer Academic/Plenum Publishers; 2000.
30. Sterman JD. Business dynamics: systems thinking and modeling for a complex world. Vol 19: Irwin/McGraw-Hill Boston; 2000.
31. Meadows D, Randers J, Meadows D. Limits to growth: the 30-year update. Chelsea Green Publishing; 2004.

Sharma et al. Systematic Reviews (2017) 6:183
DOI 10.1186/s13643-017-0576-6

Systematic Reviews

PROTOCOL Open Access

Social determinants of common metabolic risk factors (high blood pressure, high blood sugar, high body mass index and high waist-hip ratio) of major non-communicable diseases in South Asia region: a systematic review protocol

Sudesh Raj Sharma[1,3*], Shiva Raj Mishra[1*], Kusum Wagle[1,2], Rachel Page[3], Anna Matheson[3], Danielle Lambrick[4], James Faulkner[5], David Lounsbury[6] and Abhinav Vaidya[7]

Abstract

Background: Prevalence of non-communicable diseases has been increasing at a greater pace in developing countries and, in particular, the South Asia region. Various behavioral, social and environmental factors present in this region perpetuate common metabolic risk factors of non-communicable diseases. This study will identify social determinants of common metabolic risk factors of major non-communicable diseases in the context of the South Asian region and map their causal pathway.

Methods: A systematic review of selected articles will be carried out following Cochrane guidelines. Review will be guided by Social Determinants of Health Framework developed by the World Health Organization to extract social determinants of metabolic risk factors of non-communicable diseases from studies. A distinct search strategy will be applied using key words to screen relevant studies from online databases. Primary and grey literature published from the year 2000 to 2016 and studies with discussion on proximal and distal determinants of non-communicable risk factors among adults of the South Asia region will be selected. They will be further checked for quality, and a matrix illustrating contents of selected articles will be developed. Thematic content analysis will be done to trace social determinants and their interaction with metabolic risk factors. Findings will be illustrated in causal loop diagrams with social determinants of risk factors along with their interaction (feedback mechanism).

Discussion: The review will describe the interplay of social determinants of common NCD metabolic risk factors in the form of causal loop diagram. Findings will be structured in two parts: the first part will explain the linkage between proximal determinants with the metabolic risk factors and the second part will describe the linkage among the risk factors, proximal determinants and distal determinants. Evidences across different regions will be discussed to compare and validate and/or contrast the findings. Possible bias and limitations of this study will also be discussed.

Systematic review registration: PROSPERO CRD42017067212

Keywords: NCDs, Risk factors, Social determinants, South Asia

* Correspondence: yoursudesh@gmail.com; shivarajmishra@gmail.com
[1]Nepal Development Society, Kathmandu, Nepal
Full list of author information is available at the end of the article

Background

Global burden of non-communicable diseases (NCDs) has been increasing, and the South Asia region in particular is showing a rapid increase [1]. In this region, nearly half of the disease burden and two-thirds of the total deaths are caused by NCDs [2]. In addition to mortality, disability due to NCDs is posing a serious economic burden due to reduced productivity and poverty among affected people who need long-term care [3, 4]. Cardiovascular diseases, respiratory diseases, cancers and diabetes are four major diseases causing deaths and creating burden in this region [1]. Common risk factors for them are poor dietary habits, tobacco use and inadequate physical activity and metabolic risk factors such as high blood pressure, high blood sugar, high Body mass index (BMI) and high waist-hip ratio (WHR) [5–8] [Additional file 1: Appendix 1]. NCDs have a complex causal mechanism characterized by having multiple etiologies and factors [9]. Factors causing NCDs are influenced by an individual's behavior along with its interaction with the external socio-economic environment, on the top of the genealogical predisposition that people are born with [10, 11]. Thus, changing individuals' behavior is not adequate in itself without addressing underlying the social, economic, environmental and cultural factors collectively known as social determinants of health (SDH) [12]. A SDH framework has been proposed by the World Health Organization to elucidate these complexities [13]. This framework is based on *Social Production of Disease Theory* and integrates the best available evidences on social determinants of health. The framework is increasingly being utilized to understand and address multifactorial and complex causation of health problems like NCDs [12, 14, 15]. In the framework, the proximal determinants include behavioral and psychosocial factors, material circumstances, community capital and cohesion and health system factors whereas distal determinants include social positioning/class and socio-economic context (Fig. 1).

The lack of progress in addressing these social determinants of complex health problems indicates that our existing approaches are inadequate and may need help from an alternative science. Complexity sciences or system sciences hold the key to addressing these complex public health problems by improving our existing public health approaches [16, 17]. System sciences methods and tools are well placed for understanding the dynamic structure and emergent behavior of a social system leading to complex health problems. Frameworks like SDH could be further improved and contextualized through identifying gaps in practice, and enable better design of effective interventions if a complex systems approach is applied [18].

There is a need to understand social determinants of common metabolic risk factors of major NCDs for systematic action in the South Asia region using system science approach and tool. However, there is a scarcity of such comprehensive systematic reviews on social determinants of common metabolic risk factors in the South Asia region. This systematic review will first identify the common social determinants of major NCDs and then map the causal pathways through which those determinants interact to perpetuate common metabolic risk factors (high blood pressure, high blood sugar, high BMI and high WHR) among the adult population in South Asia.

Methods

The systematic review will be conducted following the Cochrane guidelines [19]. A Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols

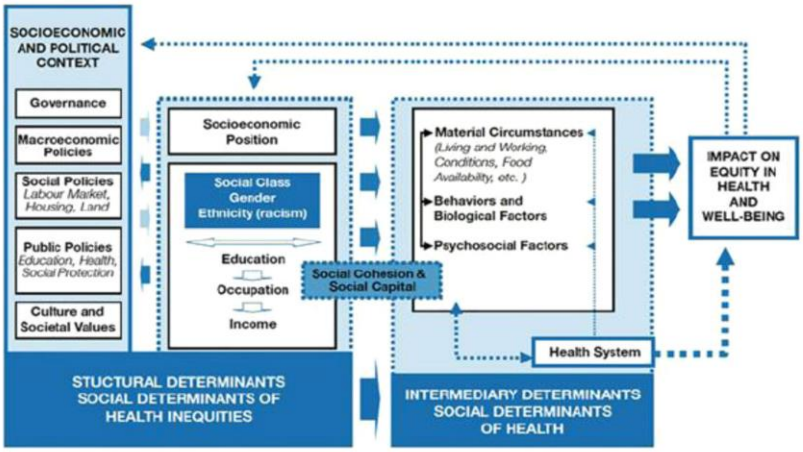


Fig. 1 Social determinants of health framework proposed by the WHO Commission on SDH (link, http://www.who.int/sdhconference/resources/ConceptualframeworkforactiononSDH_eng.pdf)

(PRISMA-P) checklist has been completed to ensure that the protocol is robust [20] [Additional file 2: Appendix II]. We will use thematic content analysis to identify social determinants of NCD risk factors and map the causal pathways leading to major NCDs in the South Asia region using the WHO framework described earlier.

Search strategy

We will search for relevant published articles and grey literature through PubMed, Embase, Web of Science and ProQuest Central using sequence of key words listed in Table 1. A detailed search strategy using Boolean operators and contractions for key search terms will be developed in consultation with a librarian at the Massey University library in Wellington.

Inclusion criteria

Inclusion criteria for selection of studies and grey literature will be as follows: (a) primary research and grey literature published between 2000 and 2016, (b) studies among an adult population aged 20–65 from South Asian region (Nepal, India, Bangladesh, Pakistan, Sri Lanka, Bhutan, Maldives, Afghanistan) and (c) studies and literature that have generated empirical evidences on proximal and/or distal determinants of the selected NCD risk factors.

Both published and unpublished, grey and peer reviewed, and qualitative and quantitative studies will be included. Any study outside of the South Asia region and not mentioning at least one of the proximal and/or one of the distal determinants from the SDH framework will be excluded [List in Additional file 3: Appendix III].

Screening procedures

Studies will be primarily screened on the basis of inclusion criteria. Two independent reviewers (SRS and KW) will review the title and abstract checking all the inclusion criteria. We will use Covidence (https://www.covidence.org/), a Cochrane Technology Platform tool to systematize the process. The secondary screening will involve full-text review, review of methods including selected cutoff values for metabolic risk factors [Additional file 1: Appendix I] and review of findings and discussion section for causal pathway analysis on social determinants of NCD risk factors. The team will exclude the duplicated articles and then finalize the list for systematic review.

Quality assessment of research papers

The selected articles will be assessed for their quality using QUALSYST tool [21]. There are many tools (for example, Effective Public Health Practice Project-EPHPP and National Institute of Health Quality Assessment Tool for quantitative studies; Popay et al. criteria and Mays et al. criteria for qualitative studies) to assess the quality of research papers [22–25], but limited tools/criteria have incorporated checklists for both qualitative and quantitative research designs. QUALYSYST tool has been validated for quality assessment of both qualitative and quantitative studies for systematic review. Further, the tool is easy to use and draws upon existing tools to address the issue of simultaneous assessment of the quality of studies which are diverse in nature. Two independent researchers (SRS and KW) will assess the quality of the studies and exclude papers with low quality score (Inter-rater agreement score of < 0.55). The final list will be agreed upon by both researchers (SRS and KW) for data extraction and analysis.

Data extraction and management

Data will be extracted from the final list of articles by the research team in an illustrative matrix as shown in Table 2.

Data analysis including mapping of causal pathways

Thematic analysis will be performed to identify patterns/themes across the extracted data/codes and stream out common pathways from determinants to risk factors of NCD simultaneously to data extraction. The team will meet regularly to check the consistency in data extraction and analysis and discuss issues, if any.

The identified causal linkages/pathways will be further consolidated as per the SDH framework and mapped in the form of causal loop diagram (CLD). CLD is a system dynamic mapping tool to express the dynamic causal

Table 1 Key words for searching articles for the review

Key words	Other variations of key words	
NCDs metabolic risk factors plus proximal determinants plus distal determinants plus geographic location	NCDs metabolic risk factors	High blood pressure, hypertension, high blood glucose, hyperglycemia, diabetes, high BMI, obesity, overweight, waist circumference, waist-hip ratio
	Proximal determinants	Determinants, risk, diet, salt intake, tobacco, smoking, alcohol, physical inactivity, lifestyle
	Distal determinants	Social determinants, education, income, gender, race, caste, ethnicity, socio-economic status, wealth index, income
	South Asia	Nepal, India, Bangladesh, Pakistan, Sri Lanka, Bhutan, Maldives, Afghanistan

Table 2 Example of illustrative matrix of selected articles

Literature type and year of publication	Research type	Study objective/ method	Study location and sample size	Metabolic risk factor	Proximal determinants	Distal determinants	Causal linkage thematic analysis
Primary article or grey literature as searched in three databases/year of publication as mentioned	Quantitative or qualitative or mixed-method research	Describe in detail about the study objective and methods	Country and region where the study was taken and sample size	Metabolic risk factor under study	See Additional file 3: Appendix III	See Additional file 3: Appendix III	Coding and thematic analysis about the possible causal linkage among determinants based on the results and discussion of the article

relationships operating among variables giving rise to a specific situation. It is based on control and feedback theory and mainly driven by the endogenous behavior of the variables in generating a specific problem and how the problem, in return, is providing feedback to the determinants. The CLD from the review will show the linkages between social determinants of common NCD risk factors, and how these determinants reinforce or balance each other. The strategy to construct CLD in this review will be based on *Business Dynamics*, a system science resource [26].

An example of casual loop diagram depicting the issue of *Junk Food control* is presented below. There are two loops in the diagram, one is balancing loop indicated by *B* in the centre of the loop and the other is the reinforcing loop indicated by *R* in the centre, see Fig. 2.

The balancing loop is a goal-seeking loop which tries to bring down the availability and affordability of the junk food however is unable to do so due to system delays (indicated by // sign in the arrow). The positive linkage (+ sign in the arrowhead) between *Junk Food availability, accessiblity and affordability* and *Health effects* indicates that the universal availability and affordability of junk food is giving rise to health effects. The increasing health effects are in-turn providing pressure to the authorities to develop regulatory policies which are delayed. These regulatory policies again have delayed implementation and are often in action when the problem has already grown out of proportion with other unintended consequences. On the left-hand side of the figure, the reinforcing loop indicates how the junk food companies utilize their profits to bolster marketing of their products and influence policy for delayed implementation of regulatory policies inorder to maintain their sales and profit. The causal loop diagram will be built using the "Vensim", a freely available software program for developing system models [27].

Discussion

The findings will describe how various social determinants interact and influence each other in the South Asian population brewing and propagating an epidemic of common metabolic risk factors of NCD. Our review will depict such interactions within and outside of the health and social systems using a causal loop diagram based on qualitative analysis of selected articles. The review will be structured in two parts. The first part would explain the linkage between proximal determinants with the metabolic risk factors. The second part will describe the linkage among distal determinants, proximal determinants and the metabolic risk factors of major NCDs in this region. Regional and country wise comparison will be done to validate and/or contrast the findings. Causal loop diagrams of social determinants of common metabolic risk factors of NCDs will provide insights on how the social determinants are linked with each other in

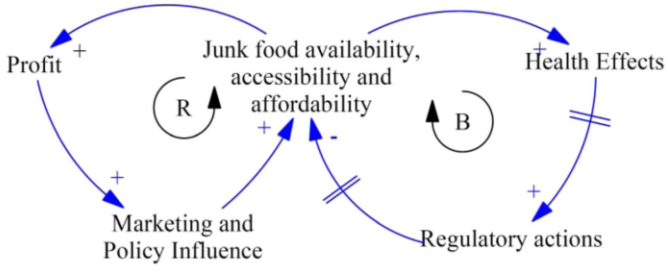


Fig. 2 Example of causal loop diagram of an issue of *Junk Food control*

perpetuating NCD problem for the South Asia region context. The review will have a much needed policy and programmatic implications in the current situation of increasing burden of NCD in South Asia. However, this review will be limited to articles written in English language and identified through four online databases.

Additional files

Additional file 1: Appendix I: Cutoff values of metabolic risk factors of NCDs (DOCX 15 kb)

Additional file 2: Appendix II: PRISMA-P checklist for the systematic review (DOCX 21 kb)

Additional file 3: Appendix III: List of proximal and distal determinants (based on SDH framework) (DOCX 16 kb)

Abbreviations
BMI: Body mass index; CLD: Causal loop diagram; NCDs: Non-communicable diseases; PRISMA-P: Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols; SDH: Social determinants of health; WHO: World Health Organization; WHR: Waist-hip ratio

Acknowledgements
We would like to acknowledge the support provided by the Nepal Development Society and Massey University Library.

Funding
The authors have received no funding for carrying out this review.

Availability of data and materials
Not applicable.

Authors' contributions
SRS conceived and drafted the initial manuscript. SRM, RP, AM, JF, KW, DL and AV all critically reviewed and revised the initial manuscript. SRS and KW prepared the final manuscript. All authors read and approved the final manuscript.

Authors' information
Sudesh Raj Sharma (MPH, MHCom.) is a public health professional from Nepal and is currently studying for a PhD at Massey University. Shiva Raj Mishra (MPH) is a cardiovascular epidemiologist with skills in global health, health systems and policy. Kusum Wagle (MPH) is a researcher and is currently working at CREHPA, a research institute in Nepal. Professor Rachel Page (PhD) is Head of School of Health Sciences at Massey University with over 20 years research experience in the area of metabolism and disease process. Anna Matheson (PhD) is a public health teacher and researcher at Massey University with expertise in the social determinants of health and equity, complex systems and social intervention. Danielle Lambrick (PhD) is a Lecturer in Life Sciences within the Faculty of Health Sciences, University of Southampton. James Faulkner (PhD) is a Reader in Exercise Physiology at the University of Winchester, UK. David Lounsbury (PhD) is an Assistant Professor of Epidemiology and Population Health at the Albert Einstein College of Medicine, Bronx, NY, USA. Abhinav Vaidya (MD, PhD) is an Associate Professor at Department of Community Medicine, Kathmandu Medical College, Kathmandu, Nepal. SRS and SRM are members of Nepal Development Society (NEDS).

Ethics approval and consent to participate
Not applicable.

Consent for publication
All the authors have consent for submission and publication.

Competing interests
We declare no conflict of interest.

Publisher's Note

Author details
[1]Nepal Development Society, Kathmandu, Nepal. [2]James P. Grant School of Public Health, BRAC University, Dhaka, Bangladesh. [3]College of Health, Massey University, Wellington, New Zealand. [4]University of Southampton, Southampton, UK. [5]University of Winchester, Winchester, UK. [6]Albert Einstein College of Medicine, Bronx, NY 10461, USA. [7]Kathmandu Medical College, Kathmandu, Nepal.

Received: 22 May 2017 Accepted: 29 August 2017
Published online: 07 September 2017

References
1. Siegel KR, Patel SA, Ali MK. Non-communicable diseases in South Asia: contemporary perspectives. Br Med Bull. 2014;111(1):31–44.
2. Ghaffar A, Reddy KS, Singhi M. Burden of non-communicable diseases in South Asia. BMJ. 2004;328(7443):807.
3. Lazzari A, de Waure C, Azzopardi-Muscat N. A Systematic Review of Key Issues in Public Health. Switzerland: Springer International Publishing; 2015.
4. Dans A, Ng N, Varghese C, Tai ES, Firestone R, Bonita R. The rise of chronic non-communicable diseases in southeast Asia: time for action. Lancet. 2011; 377(9766):680–9.
5. Afshin A, Micha R, Khatibzadeh S, Fahimi S, Shi P, Powles J, Singh G, Yakoob MY, Abdollahi M, Al-Hooti S. The impact of dietary habits and metabolic risk factors on cardiovascular and diabetes mortality in countries of the Middle East and North Africa in 2010: a comparative risk assessment analysis. BMJ Open. 2015;5(5):e006385.
6. Ezzati M, Riboli E. Behavioral and dietary risk factors for noncommunicable diseases. N Engl J Med. 2013;369(10):954–64.
7. Saeed KMI. Prevalence of risk factors for non-communicable diseases in the adult population of urban areas in Kabul City, Afghanistan. Central Asian Journal of Global Health. 2014;2(2). https://cajgh.pitt.edu/ojs/index.php/cajgh/article/view/69/144.
8. World Health Organization: Global Health Observatory (GHO) data, risk factors. 2015.
9. Centers for Disease Control Prevention: Overview of non-communicable diseases and related risk factors. 2015.
10. Alamian A, Paradis G. Individual and social determinants of multiple chronic disease behavioral risk factors among youth. BMC Public Health. 2012;12(1): 224.
11. Blas E, Kurup AS. Equity, social determinants and public health programmes. Switzerland: World Health Organization; 2010.
12. Bell R, Lutz B. Disscussion paper: addressing the social determinants of non-communicable diseases. USA: UNDP; 2013.
13. Solar O, Irwin A. A conceptual framework for action on the social determinants of health, Social Determinants of Health Discussion Paper 2 (Policy and Practice). Geneva: World Health Organization; 2010.
14. Bahadori M, Sanaeinasab H, Ghanei M, Mehrabi Tavana A, Ravangard R, Karamali M. The social determinants of health (SDH) in Iran: a systematic review article. Iran J Public Health. 2015;44(6):728–41.
15. Horton K, Friel S, de Leeuw E, McKeone C, Bolam B. Fair foundations for health equity. Health Promot Int. 2015;30(suppl_2):ii2–ii7.
16. Green LW. Public health asks of systems science: to advance our evidence-based practice, can you help us get more practice-based evidence? Am J Public Health. 2006;96(3):406–9.
17. Tremblay M-C, Richard L. Complexity: a potential paradigm for a health promotion discipline. Health Promot Int. 2014;29(2):378–88.
18. Matheson A. Reducing social inequalities in obesity: complexity and power relationships. J Public Health. 2016;38(4):826–9.
19. Higgins JP, Green S. Cochrane handbook for systematic reviews of interventions. England: John Wiley & Sons. 2011;4.
20. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev. 2015;4(1):1.
21. Kmet LM, Lee RC, Cook LS. Standard quality assessment criteria for evaluating primary research papers from a variety of fields. Edmonton: Alberta Heritage Foundation for Medical Research; 2004.

k

22. Thomas B, Ciliska D, Dobbins M, Micucci S. A process for systematically reviewing the literature: providing the research evidence for public health nursing interventions. Worldviews on Evidence-Based Nursing. 2004;1(3):176–84.
23. Health NIo. Quality assessment tool for observational cohort and cross-sectional studies. *National Heart, Lung, and Blood Institute Available from: www nhlbi nih gov/health-pro/guidelines/in-develop/cardiovascular-risk-reduction/tools/cohort [Accessed November 5, 2015]* 2014.
24. Mays N, Pope C. Qualitative research in health care: assessing quality in qualitative research. BMJ. 2000;320(7226):50.
25. Popay J, Rogers A, Williams G. Rationale and standards for the systematic review of qualitative literature in health services research. Qual Health Res. 1998;8(3):341–51.
26. Sterman JD. Business dynamics: systems thinking and modeling for a complex world. Boston: Irwin/McGraw-Hill; 2000.
27. Vensim Home [http://vensim.com/].

List of presentation in Conferences and Seminars:

S.N.	Title	Conference/Seminar	Remarks
1	Understanding the social determinants of non-communicable diseases in Nepal: a PhD study based on systems thinking approach	PhD Colloquium- System Dynamic Conference, Netherlands	Poster; July 2015
2	Understanding the social determinants of non-communicable diseases in Nepal: a systems perspective (Preliminary findings)	Centre for Metabolic Health Research (CMHR): Annual Symposium, Massey University	Oral; June 2017
3	How the production and consumption of home-made alcohol contributes to non-communicable disease in Bhaktapur, Nepal: a systems perspective	System Dynamics Conference, US	Poster; July 2017
4	Understanding the social determinants of non-communicable diseases in Nepal: a systems perspective (Updated)	Centre for Metabolic Health Research (CMHR): Annual Symposium, Massey University	Oral, June 2018
5	"Tobacco and alcohol use are playing critical role in the interaction of social determinants of non-communicable diseases in Nepal": a systems perspective	IUHPE World Conference on Health Promotion, New Zealand	Oral; April 2019
6	Health and social system challenges to tackle social determinants of non-communicable diseases in Nepal: a systems analysis	IUHPE World Conference on Health Promotion, New Zealand	Poster; April 2019
7	"The role of dietary and physical activity risks in the interaction of social determinants of non-communicable diseases in Nepal": a systems perspective	Massey University Lunchtime Seminar	Oral, May 2019

8	"The role of dietary and physical activity risks in the interaction of social determinants of non-communicable diseases in Nepal": a systems perspective	System Dynamics Conference, US	July, 2019

Appendix II: Study tools

Key informant interview with Policy level informants

Date:

Organisation:

- Can you please share your brief background and current role in your organisation?
- How do you consider the current situation of NCD in Nepal?
- How are you/your organisation associated with prevention of NCD or its risk factors or both?
- What are the key challenges or barriers in the primary prevention and control of NCD at policy and implementation level?

  Policy level
    - NCD specific policies and programs formulation and implementation
    - Laws formulation and implementation
    - Funding for primary prevention of NCD
    - Multisector policies and collaboration mechanism
    - Health System structure and functioning
    - Governance (corruption and political influence)
    - Socio-political and economic context including poverty, development and federalism
    - Global context including trade policies and globalisation

  Implementation level

    - Individual behaviours
        - Risk behaviours such as tobacco use, alcohol consumption, salt intake, diet, physical activity: prevalence, age group affected, reasons for risky behaviours, cultural factors
    - District (Public) Health Office Functioning/Skills of health workers
    - Female Community Health Volunteers mobilisation
    - Multisectoral collaboration
    - Local socio-economic, political and cultural factors (including community capital/stakeholder collaboration)

- What could be the way forward in the primary prevention and control of NCD at policy and implementation level?
- Is there anything else that you would like to tell us so that we have a better understanding of the NCD situation in the country, or are there any issues you feel are important that we have not touched on during the interview?

At the end of the interview:

- Thank the interviewee for taking time to share the valuable information

Key informant interview with District level stakeholders

Date:

Organisation:

- Can you please share your brief background and current role in your organisation?
- How do you consider the current situation of NCD in Nepal?
- How are you/your organisation associated with prevention of NCD or its risk factors or both?
- What are the key challenges or barriers in the prevention and control of NCD at district level?
    - Policy and directives from centre
        - Policy and programs for NCD prevention and control in district
        - Interaction with policy personnel in NCD matters
    - Individual behaviours
        - Risk behaviours such as tobacco use, alcohol consumption, salt intake, diet, physical activity: prevalence, age group affected, reasons for risky behaviours, cultural factors
    - District Health Office Functioning
        - NCD prevention programs and services including FCHV Services and PHC ORC
        - Skills of Human Resources
        - Medicines and Technologies
        - Recording and reporting
        - Multisectoral collaboration
    - Multisectoral actions if any (health, food, occupation, education, social development, law) including District Development Council planning and budgeting
    - Socio-economic, political and cultural factors (including community capital/stakeholder collaboration)
        - Local socio-economic and political context
        - Poverty, Ethnicity, Occupation, Education situation

        - Community capital (Neighbourhood, Social inclusion, Social Groups) and community participation in health facilities and services
- What could be the way forward in the prevention and control of NCD at district?
- Is there anything else that you would like to tell us so that we have a better understanding of the NCD situation in the district, or are there any issues you feel are important that we have not touched on during the interview?

At the end of the interview:

- Thank the interviewee for taking time to share the valuable information

Key informant interview with VDC/Municipality stakeholder

Date:

Organisation:

- Can you please share your brief background and current role in your organisation?
- How do you consider the current situation of NCD?
- How are you/your organisation associated with prevention of NCD or its risk factors or both?
- What are the key challenges or barriers in the prevention and control of NCD at community level?
    - Individual behaviours
        - Risk behaviours such as tobacco use, alcohol consumption, salt intake, diet, physical activity: prevalence, age group affected, reasons for risky behaviours, cultural factors
    - Health institution functioning and support
        - NCD prevention programs and services including FCHV Services and PHC ORC
        - Skills of Human Resources
        - Medicines and Technologies
        - Recording and reporting
        - Multisectoral collaboration
    - Multisectoral actions if any (health, food, occupation, education, social development, law) including VDC/Municipality planning and budgeting
    - Socio-economic, political and cultural factors (including community capital/stakeholder collaboration)
        - Local socio-economic and political context
        - Poverty, Ethnicity, Occupation, Education situation
        - Community capital (Neighbourhood, Social inclusion, Social Groups) and community participation in health facilities and services
- What could be the way forward in the prevention and control of NCD at community level?

- Is there anything else that you would like to tell us so that we have a better understanding of the NCD situation in the community, or are there any issues you feel are important that we have not touched on during the interview?

At the end of the interview:

- Thank the interviewee for taking time to share the valuable information

Focus Group Study Guidelines

- Can you please share your brief background and the metabolic risk factor (High BP, Blood sugar or BMI) of NCD you (or family member) are suffering from?
- How do you consider the current situation of NCD in your community?
- What are the key challenges or barriers in the prevention and control of NCD at community level?
    - Individual behaviours
        - Risk behaviours such as tobacco use, alcohol consumption, salt intake, diet, physical activity: prevalence, age group affected, reasons for risky behaviours, cultural factors
    - Material circumstances
        - Communities and neighbourhood environment like violence, poverty level, education level and housing status, parks and recreations, roads, public transport
        - Material availability and adequacy for quality of life and wellbeing (housing, water, sanitation, fuel wood, shops)
    - Psychosocial factors
        - Individual Stress especially work and family related
        - Social stress relating to living conditions and social cohesion
    - Community capital/Cohesion
        - Network, Trust, Support, Collaboration
    - Health institution functioning and support
        - NCD prevention programs and services including FCHV Services and PHC ORC
        - Skills of Human Resources
        - Medicines and Technologies
        - Multisectoral actions if any (health, food, occupation, education, social development, law) including VDC/Municipality planning and budgeting
    - Socio-economic, political and cultural factors (including community capital/stakeholder collaboration)
        - Local political context
        - Poverty, Ethnicity, Occupation, Education

- What could be the way forward in the prevention and control of NCD at community level?
- Is there anything else that you would like to tell us so that we have a better understanding of the NCD situation in the community, or are there any issues you feel are important that we have not touched on during the interview?

At the end of the discussion:

- Thank the focus group for taking time to share the valuable information

Expanded guidelines

- Policy level issues
  - Global Context
    - Globalisation and Trade policies relating to global food products, tobacco products, alcohol products (affecting NCD)
    - Global advocacy for political commitment for NCD and its influence on policy sphere
      - Existing framework (FCTC, GAPPNCD)
      - Global response to NCD
  - Socio-political context
    - Reflection of political values and priorities in policy and practice relating to issues such as NCD prevention (Documents review)
      - Enforcing policy control on harmful products like tobacco and alcohol (including controlling aggressive marketing and political lobbying and increasing tax)
    - General values and priorities of political organisations towards health promotion and public health and social development (Political Will for "Health in all" policies)
    - Perception of policy makers towards NCD as a development challenge (Macro-economic cost; Health and wellbeing of economically active population) in particular the global movement
    - Influence of changing scenarios including issues of federalism and social inclusion in New Nepal with respect to health equity and access issues
    - Effect of recent devastating earthquake in priorities and funding
  - Policies relating to health, food, occupation, education, social development affecting NCD prevalence (National Response to NCD)

- Status of NCD agenda inclusion in current policies
    - 3 Year periodic plan (economic, education, health, occupation)
    - Health Sector five year Plan
    - Education Sector five year Plan
    - Gender empowerment and social inclusion strategy
    - Social Health Insurance Policy
    - Urban Health Policy and strategies
    - NCD Prevention Plan
    - Tobacco and Alcohol Control Law/Regulations
    - Taxes on sugary products, tobacco, alcohol
- Status of current formulation of those policies and way forward
    - Addressing social stratification based on ethnicity, socio-economic status, education and occupation
    - Addressing inequity in access to education and health
    - Effectiveness of regulation relating to alcohol, tobacco, trans fat, excess sugar and salt (production and consumption)
        - Tax
        - Advertisement
        - Selling
    - Urban development and planning for parks

- Governance issues affecting NCD prevention/control
    - Performance of bureaucracy (Social sector)
    - Political influence and corruption for effective functioning of social sector
    - Inter-ministerial and inter-department committees for NCD prevention
    - Cross-sectional action teams
- Health System Structure

- Health System policy structure for NCD Prevention
- Health System Coverage and Access Issues
- Addressing NCD through overstretched health system
- Governance and corruption
- Inter-department committees for NCD prevention

- Funding of NCD primary prevention actions
  - Policies and strategies and actions specific to NCD
  - Budget allocation per year for NCD prevention
  - Donor support/fund for NCD prevention
- Multisector collaboration mechanism
  - Engagement with private sectors (Health, education, development)
  - Integrated budgeting and accounting
  - Monitoring progress and accountability for NCD prevention

- Implementation level Issues
  - Policy and directives from centre
    - Policy and programs for NCD prevention and control in district
    - Effective law formulation at local level especially relating to tobacco and alcohol
    - Interaction with policy personnel in NCD matters
  - District Health Office Functioning
    - NCD prevention programs and services including FCHV Services and PHC ORC (Quality of care)
    - Skills of Human Resources relating to NCD prevention
    - Medicines and Technologies
    - Recording and reporting
    - Intersectoral collaboration
    - Intersectoral actions if any (health, food, occupation, education, social development, law) including DDC/Municipality/VDC planning and budgeting

        - Coordination with Municipality and VDC Offices for discharging NCD prevention actions
- Socio-economic, political and cultural factors (including community capital/stakeholder collaboration)
    - Local political context
    - Poverty, Ethnicity, Occupation, Education
- Community capital/Cohesion
    - Network, Trust, Support, Collaboration
- Material circumstances
    - Communities and neighbourhood environment like violence, poverty level, education level and housing status, parks and recreations, roads, public transport
    - Material availability and adequacy for quality of life and wellbeing (housing, water, sanitation, fuel wood, shops)
- Psychosocial factors
    - Individual Stress especially work and family related
    - Social stress relating to living conditions and social cohesion
- Individual behaviours: Risk behaviours such as tobacco smoking, alcohol consumption, salt, diet, physical activity): prevalence, age group affected, reasons for risky behaviours, intersectoral actions
    - Cultural beliefs, norms and practices relating to eating and drinking habits (What shapes norms?; including urban and rural culture of way of consuming outside of home)
    - Perception towards body size and image (big body size represents prosperity and fitness)
    - Perception towards smoking and drinking
    - Perception towards readymade food and access to children
    - Perception to healthy behaviour and disease prevention

Appendix III: Interview and FGD participant's profile

Key-informants Profile

S.N.	Interview ID	Level	Background and Sector
Policy Level			
1	1	Policy Level	Health (Government)
2	2	Policy Level	Health (Government)
3	3	Policy Level	Health (Government)
4	4	Policy Level	Health (Non-government)
5	5	Policy Level	Health (Non-government)
6	6	Policy Level	Health (Government)
7	7	Policy Level	Health (Government)
8	8	Policy Level	Health (Government)
9	9	Policy Level	Health (Non-government)
10	10	Policy Level	Health (Non-government)
11	11	Policy Level	Health (Government)
12	12	Policy Level	Health (Government)
13	13	Policy Level	Health (Government)
14	14	Policy Level	Health (Government)
15	15	Policy Level	Health (Government)
16	16	Policy Level	Non-health (Government)
17	17	Policy Level	Non-health (Government)
18	18	Policy Level	Health (Non-government)
19	19	Policy Level	Health (Government)
20	20	Policy Level	Non-health (Government)
21	21	Policy Level	Non-health (Government)
22	22	Policy Level	Non-health (Government)
23	23	Policy Level	Health (Government)
24	24	Policy Level	Non-health (Government)
Bhaktapur			
1	25	District Level (Bhaktapur)	Health (Government)
2	26	District Level (Bhaktapur)	Health (Government)
3	27	District Level (Bhaktapur)	Non-health (Government)
4	28	District Level (Bhaktapur)	Non-health (Government)
5	29	District Level (Bhaktapur)	Non-health (Government)

6	30	District Level (Bhaktapur)	Health (Non-government)
7	31	VDC Level (Bhaktapur)	Health (Government)
8	32	VDC Level (Bhaktapur)	Non-health (Government)
9	33	VDC Level (Bhaktapur)	Health (Government)
10	34	VDC Level (Bhaktapur)	Non-health (Government)
11	35	VDC Level (Bhaktapur)	Health (Government)
12	36	VDC Level (Bhaktapur)	Health (Government)
13	37	VDC Level (Bhaktapur)	Health (Government)
14	38	VDC Level (Bhaktapur)	Health (Government)
15	39	VDC Level (Bhaktapur)	Non-health (Government)
16	41	Municipality Level (Bhaktapur)	Health (Government)
17	42	Municipality Level (Bhaktapur)	Health (Government)
18	43	Municipality Level (Bhaktapur)	Health (Non-government)
19	44	Municipality Level (Bhaktapur)	Non-health (Non-government)
Morang			
1	45	District Level (Morang)	Health (Government)
2	46	District Level (Morang)	Health (Government)
3	47	District Level (Morang)	Non-health (Government)
4	48	District Level (Morang)	Non-health (Government)
5	49	District Level (Morang)	Non-health (Government)
6	50	District Level (Morang)	Non-health (Government)
7	51	District Level (Morang)	Non-health (Government)
8	52	District Level (Morang)	Health (Non-government)
9	53	VDC Level (Morang)	Health (Government)
10	54	VDC Level (Morang)	Non-health (Government)
11	55	VDC Level (Morang)	Non-health (Government)
12	56	VDC Level (Morang)	Health (Government)
13	57	Municipality Level (Morang)	Health (Government)
14	58	Municipality Level (Morang)	Health (Government)
15	59	Municipality Level (Morang)	Health (Government)
16	60	Municipality Level (Morang)	Health (Non-government)
17	61	VDC Level (Morang)	Health (Government)
18	62	VDC Level (Morang)	Health (Non-government)
19	63	VDC Level (Morang)	Non-health (Government)
20	64	VDC Level (Morang)	Health (Government)

FGD Participants Profile

S.N.	FGD ID	Nature of Participants/Community	No.	Composition (Male, Female)	Location
1	65	Urban Morang; A religious minority group; a central but crowded settlement in the city).	5	5,0	Biratnagar
2	66	Urban Morang; A community of predominantly mixed ethnicity group from Madhesi Community; a peripheral settlement)	6	2,4	Biratnagar
3	67	Rural Morang; A community of predominantly dis-advantaged ethnicity group; increasing urban influence; a peripheral settlement from the centre of the VDC)	7	6,1	Bahuni
4	68	Rural Morang; A community of predominantly advantaged ethnicity group; increasing urban influence; a central settlement from the centre of the VDC)	8	4,4	Bahuni
5	69	Peri-urban Morang; A community of predominantly dis-advantaged ethnicity group; increasing urban influence; a peripheral settlement from the centre of the VDC)	8	1,7	Tankisinwari
6	70	Peri-urban Morang; A community of predominantly advantaged ethnicity group; increasing urban influence; a central settlement from the centre of the VDC)	6	4,2	Tankisinwari
7	71	Urban Bhaktapur ; A community of predominantly immigrants with both disadvantaged and advantaged ethnic groups; mixed participants mainly comprising of immigrants from different parts of Nepal)	9	7,2	Thimi
8	72	Urban Bhaktapur ; Group comprising of local residents, immigrants mainly representing advantaged ethnicity and some disadvantaged groups; mixed participants)	8	7,1	Thimi
9	73	Disadvantaged Community Group; A typical settlement with traditionally dis-advantaged groups who were affected by recent earthquake; a rural community with increasing urban influence; settlement in the farther or peripheral part of the VDC	10	6,4	Dadhikot

10	74	Advantaged Community Group; settlement in the central part of the VDC	7	2,5	Dadhikot
11	75	Rural Bhaktapur (Transforming into Peri-urban); A community of predominantly dis-advantageous ethnicity group; Effect of recent earthquake; Increasing urban influence; a peripheral settlement in the VDC.	7	4,3	Sipadol
12	76	Rural Bhaktapur (Transforming into Peri-urban); A community of predominantly advantageous ethnicity group; Effect of recent earthquake; Increasing urban influence; a central settlement in the VDC.	9	6,3	Sipadol

Appendix IV: Causal loop diagramming guidelines

A general guideline for causal loop diagram development is mentioned below:

One should have a list of the causal elements to be fitted in the causal loop diagrams. As this study not only had the list but also qualitative data around causal mechanism and/or dynamic interactions of the social determinants of NCDs, the causal loop diagram development process was iterative and informed by the qualitative data analysis.

	Guidelines
Selecting Variable Names	1. Using noun phrases to represent the elements (and not verbs); the actions in CLD are demonstrated by arrows (not elements). E.g. "Fund" is appropriate than "Low Funding". The sign of the arrow shows the direction of the change (+ for the same or – for opposite). Same change means "Decrease" leads to "Decrease" and opposite change means "Increase lead to "Decrease".
	Defining variables that can be easily quantified and can vary over time. E.g. "Actual Quality of Care" instead of "State of Quality of Care"
	Using element name which imply positive sense is preferred.
Loop construction	Causal loop or link should indicate direction of causation, and not just time sequence or temporality only. (See "Causation" in Basic Epidemiology by Ruth Bonita, et. al.: temporality; plausibility, consistency, strength, dose-response, reversibility, study design and scientific judgement)
	As one is constructing causal linkages in the diagram, one should think about possible unexpected consequences/side-effects which may occur and needs mentioning. One should make decision whether these links are important to be illustrated or not.

	The negative feedback loop or balancing loop is a goal seeking loop. Usually, it becomes clearer if the goal is explicitly stated along with along with gaps that are driving the loop towards the goal.
	In order to identify and explain certain emergent behaviour, one should be clearly able to identify actual and perceived values of an element and include in causal loop elements. In many cases, there is delay before one realises the actual state. E.g. when there is an epidemiological transition (current transition to NCD); it usually takes a while before policy makers perceive this change. However, this lack of awareness of current situation among policy makers will lead to lower funding of NCD issues.
	In case a variable has multiple consequences, lump them all into one common variable name. E.g. “behavioural risk factors” for the four common risk factors i.e. tobacco use, alcohol use, diet and physical activity
	There are often short and long consequences of actions which need to be distinguished within different loops. E.g. the short term result of spending on strengthening curative services may provide instant relief to the ailing patients but on the long run it will create more inequity and poverty.
General Tips	If there is more need to explain a causal linkage between two elements, there may be a need of another intermediate variable to elucidate the causal linkage.
	An easy method to determining if a loop is balancing (B) or reinforcing (R) is to count the number of “+” or “-” in the loop. An odd number of “+,-” generally indicates a balancing loop; an even number indicates a reinforcing loop. HOWEVER, the best method is to use scientific judgement to holistically view the loop and judge if the loop is reinforcing (growth or collapse) or balancing (goal seeking)

Finally, the diagram should be as simple as possible, which is subject to earlier points. The aim of the CLD is to demonstrate the feedback mechanism of the complex issues which would then lead to identifying and understanding certain pattern of behaviour.

Appendix V: Sense making workshop participants lists

Sense Making Workshops

January-February, 2018

S.N.	Background (Sector)	Institutions	Date (Duration)
Policy Level Sense Making workshop			
1	Health (Government)	Ministry of Health	15/02/2018
2	Health (Government)	Ministry of Health	
3	Health (Government)	Ministry of Health	
4	Health (Government)	Ministry of Health	
5	Health (Government)	Ministry of Health	
6	Health (Government)	Ministry of Health	
7	Health (Academics)	University	
8	Health (Non-government)	INGO	
Morang Sense Making Workshop			
11	Health (Government)	District Public Health Office	06/02/2018
12	Health (Government)	District Public Health Office	
13	Health (Government)	District Public Health Office	
14	Health (Government)	Tankisinwari Health Post	
15	Health (Government)	Dhanpalthan Rural Municipality	
16	Health (Government)	Kadamaha Health Post	
17	Health (Government)	Biratnagar Municipality Office	
Bhaktapur Sense Making Workshop			
21	Health (Government)	District Public Health Office	28/01/2018
22	Health (Government)	District Public Health Office	
23	Health (Government)	District Public Health Office	
24	Health (Government)	District Public Health Office	
25	Health (Government)	District Public Health Office	
26	Health (Government)	District Public Health Office	
27	Health (Government)	District Public Health Office	
28	Health (Government)	Thimi Health Post	
29	Health (Government)	Sipadol Health Post	
30	Health (Government)	Dhadhikot Health Post	

Appendix VI: Ethics letters

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Date: 21 June 2016

Dear Sudesh Sharma

Re: Ethics Notification - **SOA 16/37 - Ethics application for the PhD research titled "Understanding the social determinants of non-communicable diseases in the context of Nepal: a study based on systems thinking approach"**

Thank you for the above application that was considered by the Massey University Human Ethics

Approval is for three years. If this project has not been completed within three years from the date of this letter, reapproval must be requested.

If the nature, content, location, procedures or personnel of your approved application change, please advise the Secretary of the Committee.

Yours sincerely

Dr Brian Finch
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

Research Ethics Office, Research and Enterprise
Massey University, Private Bag 11 222, Palmerston North, 4442, New Zealand **T** 06 350 5573; 06 350 5575 **F** 06 355 7973
E humanethics@massey.ac.nz **W** http://humanethics.massey.ac.nz

Government of Nepal

Nepal Health Research Council (NHRC)

Estd. 1991

Ref. No.: 102.

28 July 2016

Mr. Sudesh Raj Sharma
Principal Investigator
Massey University, New Zealand

Ref: **Approval of Research Proposal** entitled **Understanding the social determinants of non-communicable diseases in Bhaktapur and Morang districts of Nepal: a study based on systems thinking approach**

Dear Mr. Sharma,

It is my pleasure to inform you that the above-mentioned proposal submitted on 13 June 2016 (**Reg.no.163/2016** please use this Reg. No. during further correspondence) has been approved by NHRC Ethical Review Board on 27 July 2016.

As per NHRC rules and regulations, the investigator has to strictly follow the protocol stipulated in the proposal. Any change in objective(s), problem statement, research question or hypothesis, methodology, implementation procedure, data management and budget that may be necessary in course of the implementation of the research proposal can only be made so and implemented after prior approval from this council. Thus, it is compulsory to submit the detail of such changes intended or desired with justification prior to actual change in the protocol before the expiration date of this approval. Expiration date of this study is 27 August 2018.

If the researcher requires transfer of the bio samples to other countries, the investigator should apply to the NHRC for the permission. The researchers will not be allowed to ship any raw/crude human biomaterial outside the country; only extracted and amplified samples can be taken to labs outside of Nepal for further study, as per the protocol submitted and approved by the NHRC. The remaining samples of the lab should be destroyed as per standard operating procedure, the process documented, and the NHRC informed.

Further, the researchers are directed to strictly abide by the National Ethical Guidelines published by NHRC during the implementation of their research proposal and submit progress report and full or summary report upon completion.

As per your research proposal, the total research amount is **US$ 2,490.00** and accordingly the processing fee amount to **NRs. 10,712.00**. It is acknowledged that the above-mentioned processing fee has been received at NHRC.

If you have any questions, please contact the Ethical Review M & E section of NHRC.

Thanking you,

.....
Dr. Khem Bahadur Karki
Member-Secretary

Appendix VII: Information Sheets (Interview, Workshop and FGD)

Understanding the social determinants of non-communicable diseases in Nepal

INFORMATION SHEET (Interview and Workshop Participants)

Thank you for your interest in the study. Please read everything below before deciding to take part in the study. The information sheet will tell you about the study, information needed from you and your rights as a participant. If you decide not to participate, we totally understand and respect your decision.

My Introduction

Namaste, my name is Sudesh Raj Sharma and I am a PhD Student at Massey University in New Zealand. I have been working in community health development sector in Nepal for more than 5 years. My PhD research focuses on understanding the social determinants of health impacting non-communicable diseases (NCD) such as cardiovascular disease, cancer, diabetes and chronic respiratory diseases in Nepal using systems thinking approach.

What is this research project about?

In Nepal, many people are suffering from high blood pressure, high blood sugar and obesity leading to cardiovascular diseases, cancer, diabetes and respiratory diseases. This study aims to find out what and how behavioural factors (such as smoking, drinking alcohol, etc), social factors (such as education, ethnicity, occupation, income) and environmental factors (such as social capital and cohesion, health system functioning, neighbourhood features) are responsible for the non-communicable disease problem in your communities, district and overall country. The study involves interviews/focus group discussions with policy level stakeholders, district stakeholders and community people for capturing their perspectives and experience on the social determinants of NCD as well as conducting documents review and analyzing secondary quantitative survey data for detailed understanding of the social determinants i.e. behavioural, social and environment factors responsible for the complex problem of NCD. The study will also identify potential health promotion action to prevent NCD and improve general health and wellbeing of the community.

Who can take part in the study?

If you are a policy maker/senior bureaucrats/district health manager/community stakeholder working in areas of NCD prevention, I would like to kindly invite you for a semi-structured interview and/or participation in workshop. The workshop is limited to 10 participants among those interviewed and is invitation based only.

What will the participant have to do?

The participants will have to share their experience and perspective on the NCD in Nepal. They will discuss what may be the behavioural, social and environmental factors influencing the NCD epidemic at community, district and policy level and how we can prevent this NCD problem. With your insightful perspective, I hope to further understand the current situation, barriers and facilitating factors for NCD prevention in Nepal.

The semi-structured interview will take approximately 60 minutes of your time at your preferred choice of place. The workshops (1 day) will be conducted at the district levels in coordination with District (Public) Health Offices (Biratnagar and Morang) and at policy level in coordination with Department of Health Services, Ministry of Health. We will invite you to take part in the workshop which will be of about five hours. We will provide snacks and travel allowance to the participants of the workshop.

What will the researcher do with the information?

All of the information that the researcher collects will be kept confidential on a locked filing cabinet and the results will be confidential to the College of Health/Massey University research team. We may use the data that we collect in publications or during presentations, but no one will be able to tell which data is yours.

What are your rights?

As a participant, you have the following rights which will be fully respected:

- decline to answer any particular question;
- withdraw from the study at anytime;
- ask any questions about the study at any time during participation;
- provide information that his/her name will not be used unless he/she give permission to the researcher;
- be given access to a summary of the project findings when it is concluded.
- turn off the recorder anytime during the interview

What if I have any questions?

If you have any question, you can ask any member of the research team at any time (contact details at the bottom of this information sheet.

What do I do next?

If you have read and understood everything and do want to take part in this study could you please please sign the attached ‘Consent Form’ and participate in the face-to-face interview and/or Focus Group Discussion and/or Workshop.

Thank you,

Sudesh Raj Sharma
PhD Student, Massey University
Mob: +977-9851030136
Email: yoursudesh@gmail.com

Supervisors

Dr. Rachel Page (r.a.page@massey.ac.nz)

Dr. Anna Matheson (a.g.matheson@massey.ac.nz)

Dr. James Faulkner (James.Faulkner@winchester.ac.uk)

Dr. Danielle Lambrick (D.M.Lambrick@soton.ac.uk)

Local Academic Advisor (Nepal based)

Dr. Abhinav Vaidya (dr.abhinavaidya@gmail.com)

"This project has been evaluated by peer review and judged to be low risk. The study has been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research."

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern A, Application 16/37. If you have any concerns about the conduct of this research, please contact Mr Jeremy Hubbard, Chair, Massey University Human Ethics Committee: Southern A, telephone 04 801 5799 x 63487, email humanethicsoutha@massey.ac.nz.

Understanding the social determinants of non-communicable diseases in Nepal

INFORMATION SHEET (Focus Group Discussion Participants)

Thank you for your interest in the study. Please read everything below before deciding to take part in the study. The information sheet will tell you about the study, information needed from you and your rights as a participant. If you decide not to participate, we totally understand and respect your decision.

My Introduction

Namaste, my name is Sudesh Raj Sharma and I am a PhD Student at Massey University in New Zealand. I have been working in community health development sector in Nepal for more than 5 years. My PhD research focuses on understanding the social determinants of health impacting non-communicable diseases (NCD) such as cardiovascular disease, cancer, diabetes and chronic respiratory diseases in Nepal using system science approach.

What is this research project about?

In Nepal, many people are suffering from high blood pressure, high blood sugar and obesity leading to cardiovascular diseases, cancer, diabetes and respiratory diseases. This study aims to find out what and how behavioural factors (such as smoking, drinking alcohol, etc), social factors (such as education, ethnicity, occupation, income) and environmental factors (such as social capital and cohesion, health system functioning, neighbourhood features) are responsible for the non-communicable disease problem in your communities, district and overall country. The study involves interviews/focus group discussions with policy level stakeholders, district stakeholders and community people for capturing their perspectives and experience on the social determinants of NCD as well as conducting documents review and analyzing secondary quantitative survey data for detailed understanding of the social determinants i.e. behavioural, social and environment factors responsible for the complex problem of NCD. The study will also identify potential health promotion action to prevent NCD and improve general health and wellbeing of the community.

Who can take part in the study?

If you are a community person suffering from high blood pressure, high sugar or obesity and/or have a family members/friends suffering from high blood pressure, high sugar or obesity, I would like to kindly invite you to take part in a focus group discussion.

What will the participant have to do?

The participants will have to share their experience and perspective on the NCD in Nepal. They will discuss what may be the behavioural, social and environmental factors influencing the NCD epidemic at community, district and policy level and how we can prevent this NCD problem. With your insightful perspective, I hope to further understand the current situation and social determinants of NCD in the context of Nepal.

The focus group discussion will take approximately 90 minutes of your time at the local community centre (either Village Development Committee office hall or Municipality Ward Office hall). We will provide snacks to the participants after the focus group discussion

What will the researcher do with the information?

All of the information that the researcher collects will be kept confidential on a locked filing cabinet and the results will be confidential to the College of Health/Massey University research team. We may use the data that we collect in publications or during presentations, but no one will be able to tell which data is yours.

What are your rights?

As a participant, you have the following rights which will be fully respected:

- decline to answer any particular question;
- withdraw from the study at anytime;
- ask any questions about the study at any time during participation;
- provide information that his/her name will not be used unless he/she give permission to the researcher;
- be given access to a summary of the project findings when it is concluded.
- turn off the recorder anytime during the interview

What if I have any questions?

If you have any question, you can ask any member of the research team at any time (contact details at the bottom of this information sheet.

What do I do next?

If you have read and understood everything and do want to take part in this study could you please please sign the attached 'Consent Form' and participate in the face-to-face interview and/or Focus Group Discussion and/or Workshop.

Thank you,

Sudesh Raj Sharma
PhD Student, Massey University
Mob: +977-9851030136
Email: yoursudesh@gmail.com

Supervisors

Dr. Rachel Page (r.a.page@massey.ac.nz)
Dr. Anna Matheson (a.g.matheson@massey.ac.nz)
Dr. James Faulkner (James.Faulkner@winchester.ac.uk)
Dr. Danielle Lambrick (D.M.Lambrick@soton.ac.uk)

"This project has been evaluated by peer review and judged to be low risk. The study has been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research."

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director, Research Ethics, telephone 06 356 9099 x 86015, email humanethics@massey.ac.nz".

Appendix VIII: Consent Forms (Interview, Workshop and FGD)

Understanding the social determinants of non-communicable diseases in the context of Nepal: a study based on systems thinking approach

Participant Consent Form (Interview)

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to the interview being sound recorded/image recorded.

I wish/do not wish to have my recordings returned to me.

I wish/do not wish to have data placed in an official archive

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: ..... **Date:** .....

Full Name - printed .....

Understanding the social determinants of non-communicable diseases in the context of Nepal: a study based on systems thinking approach

Participant Consent Form (Focus Group)

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to the interview being sound recorded/image recorded.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: ..... **Date:** .....

Full Name - printed .....

Understanding the social determinants of non-communicable diseases in the context of Nepal: a study based on systems thinking approach

Participant Consent Form (Workshop)

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to the interview being sound recorded/image recorded.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: ..... **Date:** .....

Full Name - printed .....

Appendix IX: Glossary of key terms

Behavioural risk factors: Behavioural risk factors means the major human behaviours, which increases the risks of a person developing a disease if engaged in that behaviour for a certain period. The four major behavioural risk factors of NCDs that are linked with increasing burden of the four traditional NCDs and are considered as global health priority include tobacco use, alcohol consumption, physical inactivity and poor dietary practices.

Causal Loop Diagram: A causal loop diagram is a system mapping method that maps the dynamic relationship of different variables within a system and is an important tool for identifying the feedback structure of a system. The feedback loops have a direction and can be reinforcing or balancing.

Case study: Case study is a qualitative research method that involves in-depth inquiry of any problem and its related context.

Health system: Health system for this research project refers to the healthcare delivery system led by the Ministry of Health and Department of Health services of Nepal. The health system boundary can be extended to include intersectoral coordination structure as well. District Health System includes the health care delivery imparted by the local hospitals and health institutions which also coordinated with other district entities for prevention of disease and promotion of health.

NCDs metabolic risk: The metabolic risk factors of NCDs are the metabolic changes within the body that elevates the risks of NCDs. They include high blood pressure, high blood sugar, high cholesterol and obesity and are key indicators of NCDs prevalence. They are often measured through community-based surveys to gauge the situation of NCDs, mainly in developing countries where reliable data of actual NCDs are not available. In this research, we had to interchangeably use NCD and metabolic risks as disease during interviews and focus group discussions as many participants at the local level considered both NCDs and metabolic risks as NCDs. The strategy ensured that the community people effectively participated in the interviews and focus group discussion

as they were more familiar with metabolic risk and could relate them to the social determinants.

Non-communicable diseases (NCDs): NCDs, also known as chronic diseases, are non-infectious and non-transmissible diseases and affects an individual for long duration. NCDs are the leading cause of mortality and disease burden worldwide with 85% of premature mortality from NCDs occurring in low- and middle-income countries. World Health Organisation has mainly framed NCDs prevention and control efforts around the four traditional NCDs i.e. cardiovascular diseases (heart attacks and stroke), cancers, chronic respiratory diseases (chronic obstructive pulmonary diseases and asthma) and diabetes, which together account for more than 80% of NCDs related deaths.

Social determinants of health: According to the World Health Organization (WHO), the social determinants of health (SDH) are the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels. The social determinants of health are mostly responsible for health inequities - the unfair and avoidable differences in health status seen within and between countries. Global health actions are increasingly emphasising on preventative action with SDH focus. WHO in 2005 formed an expert panel commission to review various evidences relating to social determinants of health. The commission proposed a SDH framework to show the structure and relationship among social determinants of health. The SDH framework has categorised the social determinants into two interlinked components: “Structural determinants” and “intermediary determinants”. Social capital and social cohesion has been proposed to occupy the contested space within each of the two components (structural and intermediary) and is critical to health and well-being of communities.

> *Structural Determinants:* Structural determinants constitute the broader socio-political context and its influence in creating social stratification.
>
> *Intermediary determinants:* Intermediary determinants constitute behavioural, material, psychosocial and health system determinants and their linkage with structural determinants in influencing the disease distribution. *Social system:* The social systems constitute health, education, local development, agriculture,

women development, animal husbandry and any social sector who often are required to work together for the social development of the communities in Nepal.

Socio-economic circumstances: In this study, socio-economic circumstances indicated socio-economic situation of families or communities determined by their income level and/or their ethnicity. We have interchangeably used socio-economic circumstance or conditions or status. We have not attempted to measure income or ethnicity based disadvantage levels but relied on the responses from the participants and stakeholders to indicate the socio-economic circumstances (again based on income and/or ethnicity) of families and communities. Low income and marginalised ethnicity group were considered to have poor socio-economic circumstances and categorized as disadvantaged communities. Such disadvantaged communities comprised of historically marginalised ethnic groups and majority of the community members are of low income groups.

System Dynamics: System Dynamics is a systems science method that aims to study the dynamic interactions of the components of a system as a whole.

Systemic intervention: Systemic Intervention is a methodological approach based on systems thinking which supports multi-methods and stakeholders' engagement for the pursuits of the action.

Systems thinking: Systems thinking has often been used as a concept to see the dynamic interactions of the various determinants from a holistic perspective. Systems science is one of the sciences that adopts systems thinking approach.

Appendix X: Statements of contributions (DRC 16 Forms)

DRC 16

MASSEY UNIVERSITY
GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the candidate and the candidate's Primary Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of candidate:	Sudesh Raj Sharma
Name/title of Primary Supervisor:	Associate Professor Rachel Page
Name of Research Output and full reference:	
Sharma SR, Matheson A, Lambrick D, Faulkner J, Lounsbury D, Vaidya A, Page R. Individual and community experience of rising burden of non-communicable diseases in two case districts of Nepal: a qualitative exploration. 2019.	
In which Chapter is the Manuscript /Published work:	Chapter IV; Paper 1
Please indicate:	
• The percentage of the manuscript/Published Work that was contributed by the candidate:	90%
and	
• Describe the contribution that the candidate has made to the Manuscript/Published Work:	
The candidate prepared the full draft of the manuscript and conducted revisions based on the inputs and comments provided by supervisors.	
For manuscripts intended for publication please indicate target journal:	
Manuscript submitted to Global Health Promotion.	
Candidate's Signature:	Sudesh Raj Sharma Digitally signed by Sudesh Raj Sharma Date: 2019.10.29 11:56:22 +13'00'
Date:	29/10/2019
Primary Supervisor's Signature:	Associate Professor Rachel Page Digitally signed by Associate Professor Rachel Page Date: 2019.10.29 13:43:21 +13'00'
Date:	29/10/2019

(This form should appear at the end of each thesis chapter/section/appendix submitted as a manuscript/ publication or collected as an appendix at the end of the thesis)

MASSEY UNIVERSITY
GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the candidate and the candidate's Primary Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of candidate:	Sudesh Raj Sharma
Name/title of Primary Supervisor:	Associate Professor Rachel Page
Name of Research Output and full reference:	
Sharma SR, Matheson A, Lambrick D, Faulkner J, Lounsbury D, Vaidya A, Page R. "Tobacco and alcohol use are playing critical role in the interaction of social determinants of non-communicable diseases in Nepal": a systems perspective. 2019.	
In which Chapter is the Manuscript /Published work:	Chapter IV; Paper 2
Please indicate:	
• The percentage of the manuscript/Published Work that was contributed by the candidate:	90%
and	
• Describe the contribution that the candidate has made to the Manuscript/Published Work:	
The candidate prepared the full draft of the manuscript and conducted revisions based on the inputs and comments provided by supervisors.	
For manuscripts intended for publication please indicate target journal:	
Manuscript submitted to BMC Public Health.	
Candidate's Signature:	Sudesh Raj Sharma Digitally signed by Sudesh Raj Sharma Date: 2019.10.29 11:51:00 +13'00'
Date:	29/10/2019
Primary Supervisor's Signature:	Associate Professor Rachel Page Digitally signed by Associate Professor Rachel Page Date: 2019.10.29 13:45:27 +13'00'
Date:	29/10/2019

(This form should appear at the end of each thesis chapter/section/appendix submitted as a manuscript/ publication or collected as an appendix at the end of the thesis)

MASSEY UNIVERSITY
GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the candidate and the candidate's Primary Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of candidate:	Sudesh Raj Sharma
Name/title of Primary Supervisor:	Associate Professor Rachel Page
Name of Research Output and full reference:	
Sharma SR, Matheson A, Lambrick D, Faulkner J, Lounsbury D, Vaidya A, Page R. The role of dietary practices and physical activity in the interaction of social determinants of non-communicable diseases in Nepal: a systemic analysis. 2019.	
In which Chapter is the Manuscript /Published work:	Chapter IV; Paper 3
Please indicate:	
• The percentage of the manuscript/Published Work that was contributed by the candidate:	90%
and	
• Describe the contribution that the candidate has made to the Manuscript/Published Work:	
The candidate prepared the full draft of the manuscript and conducted revisions based on the inputs and comments provided by supervisors.	
For manuscripts intended for publication please indicate target journal:	
Manuscript will be submitted to Plos One.	
Candidate's Signature:	Sudesh Raj Sharma Digitally signed by Sudesh Raj Sharma Date: 2019.10.29 11:51:23 +13'00'
Date:	29/10/2019
Primary Supervisor's Signature:	Associate Professor Rachel Page Digitally signed by Associate Professor Rachel Page Date: 2019.10.29 13:47:47 +13'00'
Date:	29/10/2019

(This form should appear at the end of each thesis chapter/section/appendix submitted as a manuscript/ publication or collected as an appendix at the end of the thesis)

MASSEY UNIVERSITY
GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the candidate and the candidate's Primary Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of candidate:	Sudesh Raj Sharma
Name/title of Primary Supervisor:	Associate Professor Rachel Page
Name of Research Output and full reference:	
Sharma SR, Matheson A, Lambrick D, Faulkner J, Lounsbury D, Vaidya A, Page R. Health and social system challenges to tackle social determinants of NCDs in Nepal: a systemic analysis. 2019.	
In which Chapter is the Manuscript /Published work:	Chapter IV; Paper 4
Please indicate:	
• The percentage of the manuscript/Published Work that was contributed by the candidate:	90%
and	
• Describe the contribution that the candidate has made to the Manuscript/Published Work:	
The candidate prepared the full draft of the manuscript and conducted revisions based on the inputs and comments provided by supervisors.	
For manuscripts intended for publication please indicate target journal:	
Manuscript will be submitted to Global Health: Science and Practice.	
Candidate's Signature:	Sudesh Raj Sharma Digitally signed by Sudesh Raj Sharma Date: 2019.10.29 11:54:16 +13'00'
Date:	29/10/2019
Primary Supervisor's Signature:	Associate Professor Rachel Page Digitally signed by Associate Professor Rachel Page Date: 2019.10.29 13:48:14 +13'00'
Date:	29/10/2019

(This form should appear at the end of each thesis chapter/section/appendix submitted as a manuscript/ publication or collected as an appendix at the end of the thesis)

MASSEY UNIVERSITY
GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the candidate and the candidate's Primary Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of candidate:	Sudesh Raj Sharma
Name/title of Primary Supervisor:	Associate Professor Rachel Page
Name of Research Output and full reference:	
Sharma SR, Matheson A, Lambrick D, Faulkner J, Page R, Mishra SR. Non-communicable disease prevention in Nepal: systemic challenges and future directions. 2017.	
In which Chapter is the Manuscript /Published work:	Appendix 1
Please indicate:	
• The percentage of the manuscript/Published Work that was contributed by the candidate:	90%
and	
• Describe the contribution that the candidate has made to the Manuscript/Published Work:	
The candidate prepared the full draft of the manuscript and conducted revisions based on the inputs and comments provided by supervisors.	
For manuscripts intended for publication please indicate target journal:	
Manuscript submitted to Global Health Promotion.	
Candidate's Signature:	Sudesh Raj Sharma Digitally signed by Sudesh Raj Sharma Date: 2019.10.30 05:54:26 +13'00'
Date:	30/10/2019
Primary Supervisor's Signature:	Associate Professor Rachel Page Digitally signed by Associate Professor Rachel Page Date: 2019.10.30 08:34:41 +13'00'
Date:	30/10/2019

(This form should appear at the end of each thesis chapter/section/appendix submitted as a manuscript/ publication or collected as an appendix at the end of the thesis)

MASSEY UNIVERSITY
GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the candidate and the candidate's Primary Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of candidate:	Sudesh Raj Sharma
Name/title of Primary Supervisor:	Associate Professor Rachel Page
Name of Research Output and full reference:	
Sharma SR, Matheson A. Systems thinking in 21st century: a call to health promoters. 2016.	
In which Chapter is the Manuscript /Published work:	Appendix 1
Please indicate:	
• The percentage of the manuscript/Published Work that was contributed by the candidate:	90%
and	
• Describe the contribution that the candidate has made to the Manuscript/Published Work:	
The candidate prepared the full draft of the manuscript and conducted revisions based on the inputs and comments provided by supervisors.	
For manuscripts intended for publication please indicate target journal:	
Manuscript will be submitted to Global Health: Science and Practice.	
Candidate's Signature:	Sudesh Raj Sharma Digitally signed by Sudesh Raj Sharma Date: 2019.10.30 05:54:58 +13'00'
Date:	30/10/2019
Primary Supervisor's Signature:	Associate Professor Rachel Page Digitally signed by Associate Professor Rachel Page Date: 2019.10.30 08:34:23 +13'00'
Date:	30/10/2019

(This form should appear at the end of each thesis chapter/section/appendix submitted as a manuscript/ publication or collected as an appendix at the end of the thesis)

MASSEY UNIVERSITY
GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the candidate and the candidate's Primary Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of candidate:	Sudesh Raj Sharma
Name/title of Primary Supervisor:	Associate Professor Rachel Page
Name of Research Output and full reference:	
Sharma SR, Mishra SR, Wagle K, Matheson A, Lambrick D, Faulkner J, Lounsbury D, Vaidya A, Page R.Social determinants of common metabolic risk factors (high blood pressure, high blood sugar, high body mass index and high waist-hip ratio) of maj	
In which Chapter is the Manuscript /Published work:	Appendix 1
Please indicate:	
• The percentage of the manuscript/Published Work that was contributed by the candidate:	90%
and	
• Describe the contribution that the candidate has made to the Manuscript/Published Work:	
The candidate prepared the full draft of the manuscript and conducted revisions based on the inputs and comments provided by supervisors.	
For manuscripts intended for publication please indicate target journal:	
Manuscript published in BMC Systematic Reviews	
Candidate's Signature:	Sudesh Raj Sharma Digitally signed by Sudesh Raj Sharma Date: 2019.10.30 05:54:39 +13'00'
Date:	30/10/2019
Primary Supervisor's Signature:	Associate Professor Rachel Page Digitally signed by Associate Professor Rachel Page Date: 2019.10.30 08:33:58 +13'00'
Date:	30/10/2019

(This form should appear at the end of each thesis chapter/section/appendix submitted as a manuscript/ publication or collected as an appendix at the end of the thesis)