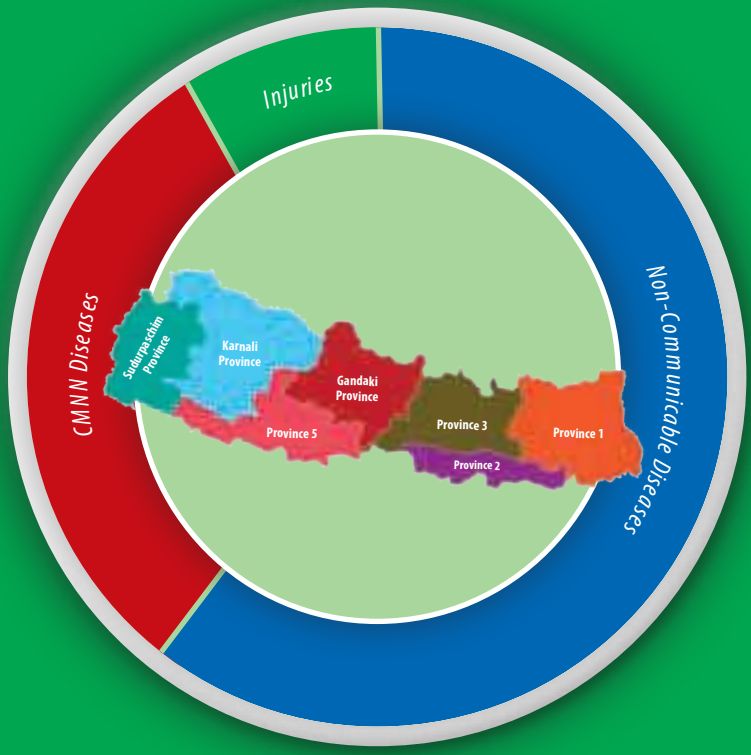
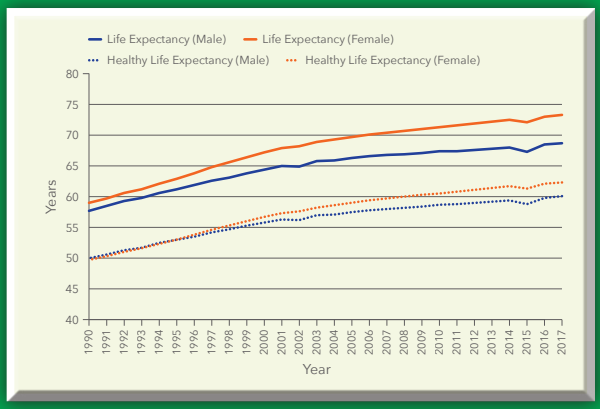
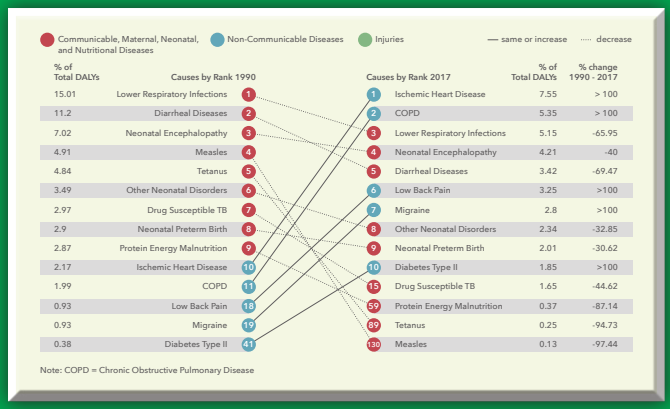
NEPAL BURDEN OF DISEASE 2017

A Country Report based on the Global Burden of Disease 2017 Study







Ministry of Health and Population

Nepal Health Research Council

IHME
Measuring what matters

UKaid
from the British people

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April 2019

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The Nepal Burden of Disease 2017 report is the result of a collaborative effort between researchers and policymakers from the Nepal Health Research Council (NHRC) and the Ministry of Health and Population (MoHP), with NHRC coordinating the overall study and report production. This study was carried out with the financial support of the UK Department for International Development (DFID). DFID Nepal Health Sector Programme 3 (NHSP3), Monitoring, Evaluation and Operational Research (MEOR) project along with the Institute for Health Metrics and Evaluation (IHME) at the University of Washington provided technical support to complete the study. The views expressed are of those who contributed to carrying out and completing the study and do not necessarily reflect the views of MoHP and DFID, the Government of Nepal, the UK Government, or IHME.

Using the Global Burden of Disease (GBD) 2017 study, this report examines health outcomes in Nepal, specifically looking at fatal and nonfatal outcomes, and risk factor analysis. It primarily describes the different aspects of Burden of Disease (BoD) in Nepal including life expectancy, causes of mortality and morbidity, causes of overall BoD (disability-adjusted life years) and risk factors causing death and disability. This report is the first national document to provide a comprehensive set of findings for the distribution of diseases and risk factors across age and sex from 1990 to 2017 for Nepal.

Additional information about the report may be obtained from the Nepal Health Research Council, Ramshahpath, Kathmandu; Telephone: +977-1-4254220; internet: http://www.nhrc.gov.np; email: nhrc@nhrc.gov.np.

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मा. उपेन्द्र यादव
Hon. Upendra Yadav
उपप्रधानमन्त्री,
स्वास्थ्य तथा जनसंख्यामन्त्री
Deputy Prime Minister,
Minister for Health and Population

नेपाल सरकार
Government of Nepal
स्वास्थ्य तथा जनसंख्या मन्त्रालय
Ministry of Health and Population

फोन : ०१-४-२०२५३४
Fax : 01-4-202565

रामशाहपथ, काठमाडौं, नेपाल ।
Ramshahpath, Kathmandu, Nepal
Website: www.mohp.gov.np

Foreword

Nepal is entering a new era as its new constitution is implemented. We are working on this implementation tirelessly within the Ministry of Health and Population (MoHP). So, it is timely that this Nepal Burden of Disease (NBoD) Report has been prepared. It too is a new initiative; it signals a new approach to evidence-based planning; it provides new insights into the burden of disease in Nepal; it offers new evidence to help determine solutions to some of our major health problems.

I would like to congratulate the Nepal Health Research Council (NHRC) and the MoHP for this excellent piece of work. It shows us that Nepal has indeed made major achievements in health: people are living longer, and communicable diseases are decreasing as a major source of disease burden. It warns us, however, that the new epidemic of non-communicable diseases has reached Nepal with their increasing burden.

The NBoD Report also links us more closely with global developments and approaches. The Report is based on collaboration the Global Burden of Disease Study, which is coordinated by the Institute for Health Metrics and Evaluation (IHME) and updated each year. The Report helps bring important external information, analysis and approaches to be shared with our own in-country expertise and knowledge. It brings us in touch with global thinking; and it allows us to share Nepal's experience and innovative approaches with neighbours and other friends around the world.

This is the first NBoD Report. It is, we know, a workinprogress and was much awaited report which provides the latest information on disease burden. This will help us to plan the policies, strategies and programmes based on the new evidence. I am very pleased, that my Ministry and its partners have started this work. I urge them to continue to strengthen and extend it year by year as a critical tool for better health policy and planning and greater achievement of health goals for the people of Nepal. I appreciate the technical support of DFID Nepal Health Sector Programme 3 (NHSP3), Monitoring, Evaluation and Operational Research project and the financial support of DFID Nepal in producing this report.

April 2019

Upendra Yadav
Deputy Prime Minister,
Minister for Health and Population

Government of Nepal
Ministry of Health and Population
Phone: 4. 262987
262590
262802
262706
262935
262862
Ramshahpath, Kathmandu
Nepal

Ref.: .....

Date : 08 April 2019

Preface

Ministry of Health and Population (MoHP) has always prioritized using evidences for devising health care interventions, and for developing policies and programmes. There are two important facets of evidence, first one, informing the disease burden – basically informing what people suffer from; and second, guiding what interventions are required and what will be the cost-effective way to address the issues. The first type of evidence required for health care decision making comes from epidemiological evidence. Burden of disease (BoD) is the comprehensive measure of overall health status that helps measure the population level outcomes. This, through the use of common outcome measures in BoD such as disability-adjusted life years (DALYs), will also allow us to estimate the input-output ratio of the major policy interventions that go to address the disease burden. Such outcome measures are comprehensively described in this report.

Nepal BoD (NBoD) 2017 report, thus, has come timely which has a comprehensive result for the population outcomes with the detailed evidence on trends and causes of morbidity, mortality and overall disease burden. This study has provided us with the latest evidence on what people are suffering from in the country.This has shown that Nepal has achieved a lot in increasing the life expectancy as well as improving the outcomes of communicable diseases, but at the same time in showing an increasing burden from non-communicable diseases (NCDs).

Revealing evidence is much more important while the health sector is passing through a big transition as the country is federalising the sector. This report adds value to the existing body of knowledge for Nepal that will support evidence-based policies and strategies development in the days to come.

In the above backdrop, I am very glad to see this NBoD report coming out with the efforts from the Nepal Health Research Council in coordination with MoHP. I would like to thank the whole team of NHRC, and the Policy, Planning, and Monitoring Division, MoHP for their commendable efforts to produce this report. I would like to thank DFID Nepal for their support extended to this end.

Mr Chandra Kumar Ghimire
Secretary

Government of Nepal
Ministry of Health and Population
Phone: 4. 262987
262590
262802
262706
262935
262862
Ramshahpath, Kathmandu
Nepal

Ref.: .....

Date : April 8, 2019

Preface

Evidence-based health care decision making, and policies and programmes development has been a continuous priority of Ministry of Health and Population (MoHP). This also has been clearly reflected in the Nepal Health Sector Strategy 2015-2020 which aims at improving use of evidence at all levels for decision making among eight other outcomes. In this regard, evidence with epidemiological information on population health is very crucial. It is important to know the magnitude of health loss resulting from diseases, and risk factors which comes from measuring the burden of disease (BoD) for the country. Nepal BoD (NBoD) 2017 report comes out to be as much required information for the country with the detailed evidence on trends and causes of morbidity, mortality and overall disease burden.

This is an important attempt to summarize the national picture on disease burden, the results of which are based on GBD 2017 study produced and updated each year by the Institute for Health Metrices and Evaluation (IHME) at the University of Washington. This study has provided us with the latest evidence on what people are suffering from in the country. This has clearly demonstrated the success we have had in improving the outcomes of communicable, maternal, neonatal, and nutritional (CMNN) diseases as well as the life expectancy of Nepalese people. Though improved, there is still a substantial burden attributed to CMNN diseases, and at the same time a growing concern is on the increasing burden of non-communicable diseases (NCDs).

Currently, as the health sector is being transitioned to a different context, in line with the realisation offederalism in the country, for us at the MoHP it is important that we make more use of evidence for our health care decision making processes.This report adds to the body of knowledge for Nepal which is likely to support the development of policies and strategies being based on the disease burden information. I have learnt that the BoD study, and accordingly this report provides information at the national level. Further to this, it is important that Nepal aims at generating sub national evidence on BoD which will be equally crucial.

I am pleased to see this NBoD report coming out with the efforts from the Nepal Health Research Council in coordination with MoHP bringing out the most comprehensive information on country picture on disease burden in a useful format that is easily accessible to the relevant stakeholders. I would like to thank the whole team of NHRC, and the Policy, Planning, and Monitoring Division, MoHP for their admirable efforts to produce this report. I am also thankful to DFID Nepal for the financial support to produce this report and DFID Nepal Health Sector Programme 3/ Monitoring, Evaluation and Operational Research (MEOR) project for their technical support.

Dr. Pushpa Chaudhary
Secretary

Government of Nepal
Ministry of Health and Population
Phone: 4. 262987
262590
262802
262706
262935
262862
Ramshahpath, Kathmandu
Nepal

Ref.: .....

Date : April 8, 2019

Preface

Epidemiological evidence forms an important element of evidence informed healthcare decision making, including informing policies and programmes. Rising above the descriptive epidemiology of prevalence and incidence of disease conditions, the Global Burden of Disease (GBD) study through a systematic effort provides a measure of magnitude of health loss due to different disease conditions and risk factors. In this context, this is a commendable effort to produce this report on Nepal burden of disease (NBoD) report based on GBD 2017 study produced and updated each year by the Institute for Health Metrices and Evaluation (IHME) at the University of Washington.

The NBoD 2017 report based on the GBD 2017 Study released in 2018, provides comprehensive BoD information for Nepal. This report has elaborated the trends and causes of mortality, premature death, disability and the overall burden of disease as measured using disability-adjusted life years. At the crucial juncture, when the country is transitioning to a different system and with the challenges and opportunities to improve country's health care delivery system coming alongside, this evidence brought together to give a national picture of the overall country BoD is very timely.

This report has clearly demonstrated the successes we have had over the past two decades in case of communicable diseases, with still some more to achieve in protecting people's health from communicable, maternal and child health disorders. On top of this, the rise of a new epidemic is clearly evident with major non-communicable diseases (NCDs)such as heart disease, chronic respiratory disease contributing to the majority of disease burden in the country. This evidence will be another addition to support contextual and adaptive policies and programmes.

Besides being compiled as a comprehensive report on disease burden for 2017, the BoD estimates from the GBD study has been equally useful for us to measure a number of Sustainable Development Goal Indicators that are specially tracking the country's progress in relation to disease burden. In addition, it is important that this kind of comprehensive information be generated for the sub-national level as well which will be better guiding the sub-national policies and strategies.

I feel very proud and pleased to see the Nepal Health Research Council leading this novel activity in coordination with MoHP to produce this important piece of evidence. I would like to thank the whole team of NHRC for their commendable efforts and the support of the Monitoring and Evaluation Section, in this division in producing this report. I appreciate the financial support ofDFID Nepal and so the DFID Nepal Health Sector Programme 3/ Monitoring, Evaluation and Operational Research project for their technical support.

Dr Bikash Devkota
Chief
Policy, Planning and Monitoring Division

Preamble

The Global Burden of Disease (GBD) study is a systematic effort to measure the magnitude of health losses due to diseases, injuries, and risk factors at a specific point in time, taking account of age, sex, and geography. Burden of disease reports represent an important contribution to evidence-based decision making in a resource limited setting, because they help decision makers to understand where constrained resources can best be invested to deliver the greatest health impacts.

I understand that this report is the first to compile evidence on Burden of Disease for Nepal. The Nepal Burden of Disease (NBoD) Report is based on the GBD 2017 study released by the Institute for Health Metrics and Evaluation (IHME) in 2018. I would like to congratulate the Nepal Health Research Council (NHRC) and Ministry of Health and Population (MoHP) for producing this NBoD Report.

The NBoD report reveals the striking successes of the last two decades of efforts in the health sector and the challenges that lie ahead. I am confident it will be a critical addition to the evidence base supporting policy and planning in the health sector in Nepal, supporting the allocation of resources based on the need reflected by the burden of different disease conditions to different categories of population. The report comes at a particularly critical time as Nepal is transitioning its health system to a federal model, and it is important to build a broad understanding of the role that the different spheres of government in making the right, and helping their constituents to make the right choices, to tackle priority health problems and reduce risk factors.

Nepalese borne in 2017 are expected to live 12.6 years longer than those borne in 1990. The report shows that while there have been huge gains in maternal and child health outcomes over the last two decades, there is still important work to be done to reduce the impact of communicable, maternal, neonatal, and nutritional (CMNN) diseases. It also highlights the increasing burden of disease (death and disabilities) attributed to non-communicable diseases (NCDs) and injuries over the period indicating the need the greater focus on policies and strategies to prevent and control NCDs and injuries.

In 2017, ischemic heart disease and chronic obstructive pulmonary disease (COPD) were the top two causes of death, but diarrheal diseases and lower respiratory infections were still amongst the top five causes of death. Two out of every three deaths in Nepal are due to NCDs, while a quarter of deaths are attributed to CMNN diseases. This highlights the need for continuing policy focus and resourcing to prevent newborns and children dying from communicable diseases. It also emphasises the need for stronger coordination and collaboration with cross sectoral stakeholders in response to the epidemiological shift from CMNN diseases to NCDs.

UK support to the health sector in Nepal has been substantial for more than two decades. I am very pleased that DFID Nepal has been able to support this important exercise to strengthen evidence-based policy making and hence maximise health gains for Nepalese people.

Dr Rurik Marsden
Head of DFID Nepal

World Health Organization

Nepal

UN House, Pulchowk, Lalitpur, Po Box 108, Kathmandu, Nepal, Tel. +977-1-5523200 Fax +977-1-5527755 E-mail: wrpnepal@who.int

8 April 2019

Message from the WHO Representative to Nepal

"What gets measured gets done" is an old saying. But it is still valid in 2019, and it is certainly still valid in Public Health.

Data drive what we do. Data help us to focus our attention where it matters most, where we can make the biggest change. Data inform policy decisions and can be the basis for individual behavior change.

The Global Burden of Disease study, on which this publication is based, brings together data from many sources to make estimates about the burden of disease worldwide. The Nepal Burden of Disease publication has extracted Nepal-specific data from this global database, to provide information specifically relevant to Nepal.

The publication provides more evidence, in addition to national and WHO statistics, that in Nepal – as in many countries – disease patterns are shifting. An example is how non-communicable diseases have overtaken communicable diseases as the main cause of mortality and morbidity in Nepal. Nepal should be proud about the programs that in the past decades have successfully pushed back maternal and child deaths, and communicable diseases, such as measles and TB. But at the same time, changes in life style have brought new risks, and with them have come non-communicable diseases that require new approaches, both for the individual and for the health system. Data, such as the ones in this report, can help to highlight such changes in trends and hence drive policy decisions.

But, as the authors point out, for some diseases and disorders, local data are lacking. For other data points, the report had to rely on surveys, which may focus on specific outcomes only. The data generated through the Health Management Information System may have been limited in scope, coverage or quality. Therefore, this report, which specifically focuses on Nepal, should also be call to colleagues in Nepal to step up efforts to improve the generation of high-quality local data, so that future reports can be based on locally-available information. The better we measure here in Nepal what goes on, the more we will be motivated to locally address our health issues.

"What gets measured, gets done" but maybe we should say: "What gets measured locally, gets done better".

Congratulations to the authors of this publication for bringing Nepal Burden of Disease data together in one publication.

Dr Jos Vandelaer
WHO Representative to Nepal

Acknowledgements

Nepal Burden of Disease 2017: A Country Report based on the Global Burden of Disease 2017 Study is the result of collaboration between Nepal Health Research Council (NHRC), Ministry of Health and Population (MoHP), the Institute for Health Metrics and Evaluation (IHME), and Monitoring Evaluation and Operational Research (MEOR) project of the United Kingdom (UK) Department for International Development (DFID) Nepal Health Sector Programme 3 (NHSP3).

Findings in this report came from the Global Burden of Disease (GBD) study coordinated by IHME, which produces comprehensive and comparable annual estimates of disease burden by country, age, and sex for more than 350 causes of diseases and injuries and 84 risk factors. Data are from the GBD 2017 study and were obtained from the IHME data visualisation tool.

At NHRC, Dr Meghnath Dhimal provided leadership in overseeing the creation of this report, and we acknowledge his sincere contribution. At IHME, Sofia Redford, Mohsen Naghavi, Katherine Leach-Kemon, Adrienne Chew, and Varsha Krish provided strategic guidance and technical support for producing this report. We would like to thank all the members from IHME who supported us in producing this report. We would like to sincerely thank Dr Bikash Devkota, Director of Policy, Planning and Monitoring Division (PPMD) at the MoHP, for his overall direction and guidance in producing the report. Similarly, Giri Raj Subedi and Dr Suresh Mehata from PPMD, MoHP also provided strategic guidance in producing this report. We would like to sincerely acknowledge their support. We would also like to sincerely acknowledge the support of Bijay Kumar Jha at NHRC for his contribution in producing this report.

The overall design of the report was outlined by Krishna Kumar Aryal, Binaya Chalise, Angela Liu and Madeline McGaughey. Data collection and analysis were conducted by Angela Liu, Madeline McGaughey, Bihungum Bista and Achyut Raj Pandey. Binaya Chalise wrote the report. Peter Godwin, Fiona Mactaggart and Krishna Kumar Aryal edited the report. Shristi Karki and Jasmine Maskey fact-checked it. Rooster Logic provided the support for designing the graphs used in the report. We express our gratitude to all the contributors. The GBD Technical Working Group (TWG) of the NHRC, and the Monitoring and Evaluation (M&E) TWG of the MoHP reviewed the report. We acknowledge the support of the members of both the TWGs. DFID/NHSP3/MEOR project provided overall technical assistance to produce this report and it was financed by DFID Nepal. We would like to acknowledge DFID Nepal and the MEOR project for their support. At last but not the least, we would like to thank everyone who directly and indirectly contributed to bring this report into the present form.

Prof Dr Anjani Kumar Jha
Executive Chairperson
Nepal Health Research Council
April 2019

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Acronyms

BoD	Burden of disease
CMNN	Communicable, maternal, neonatal, and nutritional
COPD	Chronic obstructive pulmonary disease
DALYs	Disability adjusted life years
DFID	Department for International Development
DWs	Disability weights
GBD	Global Burden of Disease
GHDx	Global Health Data Exchange
HMIS	Health Management Information System
IHME	Institute for Health Metrics and Evaluation
M&E	Monitoring and evaluation
MDGs	Millennium Development Goals
MEOR	Monitoring, Evaluation, and Operational Research
MICS	Multiple Indicator Cluster Survey
MoHP	Ministry of Health and Population
MoU	Memorandum of understanding
NBoD	Nepal Burden of Disease
NCDs	Non-communicable diseases
NDHS	Nepal Demographic and Health Survey
NHRC	Nepal Health Research Council
NHSP3	Nepal Health Sector Programme 3
NHSS	Nepal Health Sector Strategy
PPMD	Policy, Planning and Monitoring Division
SDGs	Sustainable Development Goals
SDI	Socio-demographic Index
SWAp	Sector-wide approach
TWG	Technical working group
UI	Uncertainty interval
YLDs	Years lived with disability
YLLs	Years of life lost

About the Collaborators

Nepal Health Research Council

Nepal Health Research Council (NHRC) is an autonomous apex body of the Government of Nepal for supporting health research in the country. The core functions of NHRC are evidence generation, knowledge management, research ethics, and capacity development in research methods. NHRC cooperates with the Ministry of Health and Population, non-Government agencies, the private sector, and other line ministries of the Government of Nepal to provide assistance and advice in all matters related to health research and policies.

Ministry of Health and Population

The Ministry of Health and Population (MoHP) is responsible for overall policy formulation, planning, organization and coordination of the health sector at national, province, district and community levels in Nepal. The goal of MoHP is to improve the health status of all people living in the country through effective and efficient policy formulation, resource mobilization, and monitoring and regulation of delivery of health services by different health institutions.

Monitoring Evaluation and Operational Research

Monitoring Evaluation and Operational Research (MEOR) is the UK Department for International Development (DFID) funded project designed to continuously improve and adapt DFID's Nepal Health Sector Programme 3 (NHSP3) and ensure that the intended outcomes and impact of NHSP3 and the Nepal Health Sector Strategy (NHSS) 2015–2020 are achieved. MEOR operates as an independent component under the NHSP3 umbrella, and is managed by Abt Associates. Monitoring and evaluation, operational research, and knowledge management are the key MEOR areas to support DFID in ensuring the overall achievement of NHSP3 and NHSS 2015–2020.

Institute for Health Metrics and Evaluation

The Institute for Health Metrics and Evaluation (IHME) is an independent health metrics science research center at the University of Washington that provides rigorous and comparable measurement of the world's most important health problems, and evaluates the strategies used to address them. IHME makes this information available so that policymakers have the evidence they need to make informed decisions about how to allocate resources to best improve population health.

Terms and definitions

Life expectancy at birth: Average number of years that a newborn is expected to live if current mortality rates continue to apply.

Healthy life expectancy: The number of years that a person at a given age can expect to live in good health, considering mortality and disability.

Years of life lost (YLLs): The number of years of life lost due to premature death. It is calculated by multiplying the number of deaths at each age by a standard life expectancy at that age.

Disability weights: Number on a scale from 0 to 1 that represents severity of health loss associated with a health state.

Sequelae: Consequences of diseases and injuries.

Years lived with disability (YLDs): The number of years of life lived with short-term or long-term health loss weighted by the severity (disability weight) of the disabling sequelae of diseases and injuries.

Disability-adjusted life years (DALYs): The main summary measure of population health used in Global Burden of Disease to quantify health loss. DALYs provide a metric that allows comparison of health loss across different diseases and injuries. They are calculated as the sum of YLLs and YLDs; thus, they are a measure of the number of years of healthy life that are lost due to death and nonfatal illness or impairment.

Risk factors: Potentially modifiable causes of disease and injury.

Global Burden of Disease study: A systematic, scientific effort to quantify the comparative magnitude of health loss due to diseases, injuries, and risk factors by age, sex, and geographies for specific points in time.

Socio-demographic Index (SDI): A summary measure that identifies where countries or geographic areas lie on the spectrum of development. SDI is expressed on a scale of 0 to 100, with 0 being the lowest SDI value and 100 being the highest. SDI is a composite average of the rankings of the per capita income, average educational attainment, and total fertility rate.

Summary exposure values (SEV): A measure of a population's exposure to a risk factor that considers the extent of exposure by risk level and the severity of that risk's contribution to disease burden.

Uncertainty interval (UI): A range of values that is likely to include the correct estimate of disease burden for a given cause. Narrow uncertainty intervals indicate that evidence is strong, while wide uncertainty intervals show that evidence is weaker.

Executive summary

The Global Burden of Disease (GBD) study is a systematic effort to quantify the comparative magnitude of health loss due to diseases, injuries, and risk factors by age, sex, and geographies for specific points in time. It provides a comprehensive picture of total health loss due to diseases, injuries, and death. IHME has recently produced GBD 2017 estimates, which highlight Nepal's health performance in terms of mortality, morbidity, and overall disease burden. These have been extracted to produce this Nepal Burden of Disease (NBoD) Study 2017 Report.

The GBD, and thus the NBoD Study 2017, measures overall mortality, causes of mortality, causes of morbidity, and risk factors. Overall mortality is expressed in the form of number of deaths due to diseases and injuries and their rates per 100,000 population. Causes of mortality are captured through years of life lost (YLLs), which give years of life lost due to premature death from a disease or injury. Years lived with disability (YLDs) measure causes of morbidity; they are used to indicate the number of years lived with disability due to a nonfatal disease or injury. YLLs and YLDs together give the overall burden of disease or injury. It is expressed in the form of disability adjusted life years (DALYs).

Results described in the NBoD 2017 report reveal that females are expected to live longer (73.3 years) than males (68.7 years). Life expectancy increased from 59 to 73 years for females, and 58 to 69 years for males, between 1990 and 2017. However, not all these additional years gained will be healthy ones. Females are expected to live 62 years of healthy life, while males will live 60 years of healthy life. This discrepancy between life expectancy and healthy life expectancy is due to years of healthy life lost as a result of ill health and disability.

A total of 182,751 deaths are estimated in Nepal for the year 2017. Non-communicable diseases (NCDs) are the leading causes of death – two-thirds (66%) of deaths are due to NCDs, with an additional 9% due to injuries. The remaining 25% are due to communicable, maternal, neonatal, and nutritional (CMNN) diseases. Ischemic heart disease (16.4% of total deaths), chronic obstructive pulmonary disease (COPD) (9.8% of total deaths), diarrheal diseases (5.6% of total deaths), lower respiratory infections (5.1% of total deaths), and intracerebral hemorrhage (3.8% of total deaths), were the top five causes of death in 2017. The rise of NCDs is partly due to the changing age structure and lifestyle changes such as increasing sedentary behavior, tobacco use, changes in eating habits, and harmful use of alcohol.

Similarly, out of the total (5,850,044) YLLs due to premature death (people dying earlier than their potential life expectancy), 49% are due to NCDs, 39% due to CMNN diseases and the remaining 12% due to injuries. The top five causes (all ages both sexes) of YLLs are ischemic heart disease (11.3% of total YLLs), lower respiratory infections (7.9% of total YLLs), neonatal encephalopathy (5.7% of total YLLs), COPD (5.5% of total YLLs), and diarrheal diseases (4.5% of total YLLs). The leading causes of morbidity (YLDs) are low back pain, migraine, COPD, and other musculoskeletal disorders. Approximately 59% of disease burden (including premature death and disability - DALYs) in 2017 is due to NCDs, 31% due to CMNN

diseases, and 10% due to injuries. Ischemic heart disease (7.6% of DALYs), COPD (5.4% of DALYs), and lower respiratory infections (5.2% of DALYs) are the top three disease conditions causing most of the disease burden in 2017. The findings further reveal that short gestation for birth weight (7.5% of total DALYs), high systolic blood pressure (6.7% of total DALYs), smoking (6.5% of total DALYs), high blood glucose level (5.5% of total DALYs), and low birth weight for gestation (4.7% of total DALYs) are the top five risk factors driving death and disability in Nepal.

From the results presented in the NBoD 2017 report, NCDs are increasingly becoming a major public health issue. Notably, ischemic heart disease and COPD are top causes contributing significantly to the burden of disease (BoD). Maternal and child health outcomes are improving but should not be neglected as there is still much progress to be made. Notable risk factors are metabolic risk factors, ambient and household air pollution, and finally, behavioural risk factors such as smoking. The national BoD profile in 2017 looks vastly different from 1990, or even 2007: these changes must be reviewed and addressed, and Nepal's health policy priorities, strategies, and resource allocations must adapt accordingly.

Background

Nepal is a multi-ethnic country with great socio-cultural diversity across its 29.6 million people, distributed across seven provinces and three ecological regions. The Nepalese health system has been supported by a sector-wide approach (SWAp) for external financing since 2004. Since then, three health sector strategies and implementation plans have been developed to guide the health sector (1). While the first and second strategies reflected the aspirations of the Millennium Development Goals (MDGs), the recent Nepal Health Sector Strategy (NHSS) 2015–2020 is based on Nepal's commitment to the Sustainable Development Goals (SDGs). The NHSS, and specifically Output Nine of the strategy, envisages the health sector of Federal Nepal directed by an evidence-based approach in health decision-making at all levels (2). Understanding the disease burden and risk factor trends is thus critical to provide and allocate resources and opportunities for the Nepalese population to achieve the best health outcomes. Such information is also needed for evidence-based health system and policy development.

The Health Management Information System (HMIS)[1] is a major source of evidence for morbidity and mortality indicators mainly those of communicable, maternal, neonatal, and nutritional (CMNN) diseases. The Nepal Demographic and Health Survey (NDHS) and Multiple Indicator Cluster Survey (MICS) are important national surveys that provide periodic data mostly on maternal and child health. Similarly, the Step Wise approach to Surveillance (STEPS) Survey provides periodic data on non-communicable disease (NCDs) risk factors. In addition, many small-scale local studies from different areas of Nepal provide a variety of data on the distribution of specific diseases and risk factors. A comprehensive assessment, however, of all major diseases and risk factors in terms of their burden over an extended period, has not been available thus far.

In 2006, Nepal Health Research Council (NHRC) carried out a burden of disease (BoD) study in 15 districts of Nepal. The study captured 10,095 deaths in a population of 1,085,207 using verbal autopsy through a community participation approach of identifying deaths (3). A similar type of study was carried out in a subnational population of Central Nepal in 2011, capturing 464 deaths from 131,494 sampled population (4). These studies were remarkable in terms of initiating BoD related evidence in Nepal. However, these studies ended with publication of the years of life lost (YLLs) component only, and further work on the years lived with disability (YLDs) part was not completed to get BoD measures. Furthermore, the Ministry of Health and Population (MoHP) started the BoD exercise in Nepal, with technical support from

1 HMIS was introduced in 1994, under the Management Division, to gather service statistics related to the health programmes of the MoHP It was substantially redesigned in recent years to gather accurate, comprehensive and user-friendly data, disaggregated by age, sex, caste and ethnic group, through an electronic reporting system.

the Institute for Health Metrics and Evaluation (IHME), by conducting a scoping exercise in 2014 to assess data availability for refining Global Burden of Disease (GBD) estimates for Nepal (5). This scoping exercise was supported by the UK Department for International Development (DFID), Nepal Health Sector Support Programme. Following the scoping exercise, NHRC, MoHP, and IHME signed a Memorandum of Understanding (MoU) in 2018 to refine GBD estimates for Nepal, and to gradually move in the direction of producing estimates of the burden of diseases, injuries, and risk factors at the sub national level (i.e., province or specific caste/ethnic groups) in the future. The MoU called for collaboration between NHRC, MoHP, and other stakeholders to jointly work on BoD activities in Nepal under the leadership of NHRC and MoHP. This report is an initial step towards institutionalizing BoD activities in Nepal as envisioned in the agreement between NHRC, MoHP, and IHME. In 2018, the DFID Nepal Health Sector Programme 3 (NHSP3), Monitoring, Evaluation and Operational Research (MEOR) project, within its broader aim of generating evidence that will inform and improve the delivery of both NHSP3 and the NHSS 2015–2020 signed a MoU with NHRC. With an interest in supporting the BoD exercise in Nepal, the purpose of the MoU was to work jointly on BoD analysis alongside other activities such as secondary data analysis and knowledge management.

Using the GBD 2017 study, this report examines health outcomes in Nepal, specifically looking at fatal and nonfatal outcomes, and risk factor analysis. This report is the first national document to provide a comprehensive set of findings for the distribution of diseases and risk factors across age groups and sex from 1990 to 2017. The generation of this report is a collaborative effort between researchers and policymakers from the NHRC and MoHP with support from the DFID NHSP3, MEOR project and collaboration from IHME based at the University of Washington. The comprehensive set of findings presented in this report serve as an important resource for evidence-based health planning, and for tracking disease burden as indicated in the NHSS (2015–2020) Results Framework (1) and SDG indicators for Nepal.

Outline of the report

This report has four sections. The introductory section sets the context and need for a BoD country report for Nepal. The second section describes GBD methods and the utility of BoD findings in policymaking. The third section presents the major findings from the GBD 2017 study which form the major part of NBoD 2017 report. This section starts with reporting the life expectancy status of the Nepalese population; it moves on to report the situation of mortality, causes of premature deaths, causes of disability, and causes of disease burden. The section also provides an overview of risk factors to which major causes of disease burden are attributable. The fourth section concludes the report with insights into health policy implications of the BoD 2017 results for Nepal.

The Global Burden of Disease at a glance

About the Global Burden of Disease

The GBD study is a powerful platform for understanding the main drivers of poor health at international, national, and local levels. Coordinated by the IHME, GBD measures the years lost when people die prematurely or suffer from disability. It estimates healthy years lost from over 350 diseases and injuries, and their risk factors, by age and sex, from 1990 to 2017. GBD 2017 provides for the first time an independent estimation of population for 195 countries, and a comprehensive update on fertility. New causes have been added to the fatal and non-fatal cause lists, for a total of 359 diseases and injuries. Altogether, GBD 2017 covers 84 risk factors including bullying victimization (a new risk factor), and 80 new risk-outcome pairs have also been added. The GBD findings are available for each country. GBD results can also be viewed through publicly accessible visualization tools on IHME's website at http://www.healthdata.org/results/data-visualizations.

Global Burden of Disease methods

GBD uses more than 50,000 data sources from around the world to estimate disease burden. As a first step, GBD researchers estimate child and adult mortality as well as cause-specific mortality using data sources such as vital registration systems, censuses, and household surveys. To create estimates where data are sparse or unavailable, regressions using relevant covariates are performed, as well as smoothing[2] over space, time, and age, and Gaussian process regression. A more detailed methodology can be accessed in the literature (6, 7).

Years lost due to premature death from different causes are calculated using data from vital registration with medical certification of causes of death where available, and sources such as verbal autopsies in countries where medical certification of causes of death is lacking (8). YLDs are estimated using epidemiological data, such as incidence and prevalence information, collected from several different sources. These include, but are not limited to, peer-reviewed scientific literature, surveillance systems, surveys, hospital and claims databases, and disease registries. After the data are collected and cleaned, statistical techniques are used to generate estimates for each age, sex, year, and location combination. The most widely used method in the GBD is a Bayesian meta-regression platform known as DisMod-MR. Disability weights (DWs) have been created and refined through several autonomous survey studies (9). A comorbidity micro-simulation process accounts for the comorbidity across different causes, which produces prevalence for each sequela. Once the comorbidity is accounted for, the prevalence for each sequela is combined with its DW to create

2 Smoothing is a statistical technique for removal of irregularities or noise from a dataset. Smoothing technique uses algorithms to investigate patterns and trends in a dataset.

YLDs. Once the years lost to premature death and YLDs are estimated, GBD researchers sum the two estimates to obtain disability-adjusted life years (DALYs)[3]. This is the main summary measure of population health used in GBD to quantify health loss. DALYs provide a metric that allows comparison of health loss across different diseases, injuries, and risk factors by age, sex, and geographies for specific points in time. They are calculated as the sum of YLLs and YLDs; thus, they are a measure of the number of years of healthy life that are lost due to death and nonfatal illness or impairment (10).

Finally, researchers quantify the amount of premature death and disability attributable to different risk factors using data on exposure to and effects of the different risk factors. GBD researchers use advanced statistical modeling to estimate disease burden. Summary exposure values (SEVs) of each risk factor, defined as the relative-risk-weighted prevalence of a risk factor over a population, are calculated and used to find the population-attributable fraction of each risk factor. Note that burden attributability is not mutually exclusive across risk factors, so some DALYs may be attributed to multiple risk factors.

GBD estimates are supplemented by uncertainty estimates for better understanding the GBD data. Uncertainty in all estimates is produced by propagating draws through each step of the modeling process. The initial 1,000 draws are taken from the distributions of the input data, and for each modeling component thereafter, the posterior draws of each modeling step are used as input to the next step in the process. GBD 2017 results express uncertainty estimates in the form of uncertainty intervals (UI), which are a range of upper and lower values within which a true estimate lies.

BoD 2017 results for Nepal

Using the IHME data visualization tool, we extracted BoD data for Nepal from the GBD 2017 study. Data were summarized by the causes of mortality, morbidity, and disease burden, as well as risk factors, and were presented in the form of tables and figures. GBD classifies the list of causes of health loss into four hierarchically nested categories called the levels of causes. The highest level (level one) is divided into three broad categories of CMNN diseases, NCDs, and injures. Within each of these categories, causes of health loss are broken down with increasing specificity [see example below[4]]. The finest level of detail is available at level four. Risk factors are similarly organized into four levels ranging from three broad categories in level one (behavioural risk, metabolic risk, and environmental/occupational risk) to 84 risk factors in level four. The cause and risk lists are mutually exclusive and collectively exhaustive at every level of aggregation. The NBoD is based on level four causes and risk factors extracted data from the IHME database.

As with any modeled estimates, such as weather forecasts and gross domestic product data, the findings in this report have limitations, such as those stemming from poor-quality and/or missing data. In Nepal, for example, data on leading causes of disability, particularly low back pain and mental disorders, and exposure to risk factors, are lacking. Data on causes of mortality and hospital-based morbidity are also inadequate. Nepal lacks a fully functioning national system of vital registration to gather mortality data (5). Nepal will need to improve data availability and quality to boost the accuracy of its BoD estimates. Within these limitations, however, the BoD estimates for Nepal are considered robust estimates of enough validity to amply support policymaking.

3 The preliminary form of DALYs was first used by the World Bank in 1993 in its World Development Report. It was further elaborated by Christopher Murray in 1994. The final form of DALYs was used by Christopher Murray and Alan Lopez in 1996 in the Global Burden of Disease Study (11). A detail description of DALYs is reported elsewhere (12, 13).

4 For example, consider typhoid fever, which is a level four cause in the GBD cause list. Typhoid fever is included under CMNN diseases at level one, under enteric infections at level two, under typhoid and paratyphoid diseases at level three, and alone, as typhoid fever, at level four. The database will only reveal estimates for typhoid fever at level four.

Data sources for NBoD 2017 estimates

The GBD 2017 study pooled data from more than 90,000 data sources covering the years between 1990 and 2017. These data sources take various forms, such as those obtained from censuses, vital registration, verbal autopsies[5], household surveys, disease registry, sample surveys, health information systems, police records, and published literature. The Global Health Data Exchange (GHDx) is an online platform (available at http://ghdx.healthdata.org/) constructed by IHME that provides information about data sources used in GBD 2017 study, and thus also for NBoD estimates included in this report. Data for NBoD estimates are mainly from the following sources:

- Data from the 1971–2011 Nepal Population and Housing Census.
- Disease registries such as the Kidney Disease Data Centre maintained by the International Society of Nephropathy, which captures chronic kidney disease data for Nepal covering the years 2006–2009.
- Data from Epidemiological Surveillance such as the World Health Organization (WHO) Disease Observatory.
- Periodic and ad hoc large household surveys such as NDHS, MICS, and STEPS.
- Published scientific literature, reports, and administrative records.

A comprehensive record of the Nepal dataset is available from the GHDx. Table 1 in the Annex provides an overview of major data sources for Nepal for the GBD 2017 study and the NBoD 2017 estimates included in the national report. Mortality estimates from the GBD 2017 results for Nepal are informed by censuses and large household surveys, whereas HMIS is the major source for morbidity data. However, these data sources are limited in scope, coverage, and quality. Risk factor estimates for Nepal are predominantly obtained from large household surveys, but they are confined to risk factors associated with childhood disorders, infections, and maternal outcomes. A detailed description of available data sources from Nepal and their usefulness in informing GBD estimates is reported elsewhere in the 2014 Scoping Exercise Report of IHME (5).

Importance of using BoD estimates for policymaking

BoD results allow decision-makers to compare healthy years lost from fatal conditions, such as cancer, to those lost from nonfatal conditions, such as low back and neck pain; and from different kinds of conditions, such as NCDs or maternal and childhood illnesses and mortality. The study provides much more policy-relevant information than simply cause of death data, by shedding light on conditions that cut lives short or create chronic ill-health and disability, not just those that kill people primarily in old age. The NBoD 2017 report also provides insights on potentially preventable causes of disease and injuries, known as risk factors. The study tracks common risk factors, which range from poor diets and high blood sugar to unsafe water and micronutrient deficiencies. Examining the ranking of diseases, injuries, and risk factors in Nepal can help policymakers prioritize and decide where to invest scarce resources to maximize health gains. In the longer term, Nepal can also benefit from having subnational BoD estimates for the local government level and provincial level to facilitate evidence-based decision-making at the local levels.

Learn more

To learn more about participating in GBD research, see the GBD call for collaborators at http://www.healthdata.org/gbd/call-for-collaborators or the GBD webpage at http://www.healthdata.org/gbd. GBD Technical Training Workshops provide in-depth training in GBD methods, results, and data visualizations. For more information, visit http://www.healthda-ta.org/gbd/training.

5 Verbal autopsy uses a standardized questionnaire to ascertain the cause of a death based on an interview with next of kin or other close relatives. It is used to capture causes of death in countries that lack functioning vital registration.

NBoD 2017 findings

Life expectancy

Nepal's life expectancy for both males and females combined is 70.9 (95% UI: 69.8–72.1) years. This observed life expectancy is higher than expected[6] life expectancy, which is 64.9 years, as estimated by the country's Socio-demographic Index (SDI). The same pattern can be seen for males and females, specifically. The observed life expectancy for males is 68.7 (95% UI: 67.3–70.6) years, which is 5.7 years higher than the expected life expectancy (63.0 years). The observed life expectancy for females is 73.3 (95% UI: 71.5–75.1) years, which is 6.5 years higher than the expected life expectancy (66.8 years). The observed life expectancy of females is higher than that of males by 4.5 years, which is a trend similar to that observed at the global level. Between 1990 and 2017, Nepal's life expectancy for both sexes combined has increased by 12.6 years, with most of that increase occurring after the new millennium. From 2000 to 2017, life expectancy for both sexes combined has increased by 5.1 years. A Nepalese born in 2017 can expect to live 61.1 (95% UI: 58.3–63.5) years of healthy life compared to 49.8 (95% UI: 47.3–52.2 years) years for those born in 1990. Years of healthy life increased by 11.3 between 1990 and 2017, which is consistent with the increase in life expectancy (12.6 years).

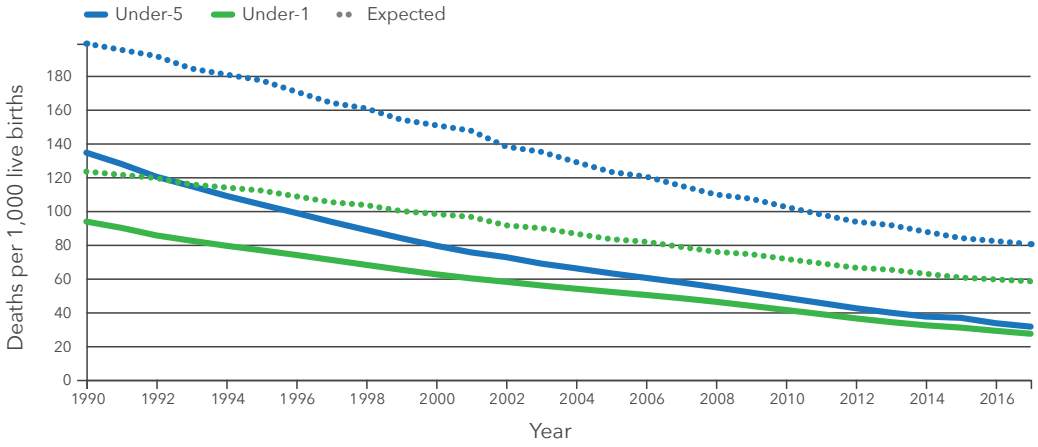
Nepalese are living longer lives than those born in 1990. However, not all those additional years gained will be healthy ones. This is more apparent in females than males.

All-cause mortality

The estimated all-ages mortality rate for both sexes combined has decreased over time, from 1,110.3 (95% UI: 1,039.8–1,183.8) deaths per 100,000 population in 1990 to 611.4 (95% UI: 556.2–661.0) deaths per 100,000 population in 2017. When broken down by age group, both under-5 and under-1 mortality rates are lower than expected [see Figure 1]. In 2017, the expected under-5 and under-1 mortality rates

Mortality rates have sharply declined over the past two decades, with the under-5 mortality rate outperforming expectations.

6 Expected life expectancy is the assumed value predicted by probability based on country's Socio-demographic Index. Expected life expectancy is used in comparison to observed life expectancy (a value that is actually observed). Statistical tests are used to measure the difference between the observed and expected values.



	Expected		Observed	
	1990	2017	1990	2017
Under-5	199.0	80.3	134.4	31.4
Under-1	123.2	58.3	93.6	27.2

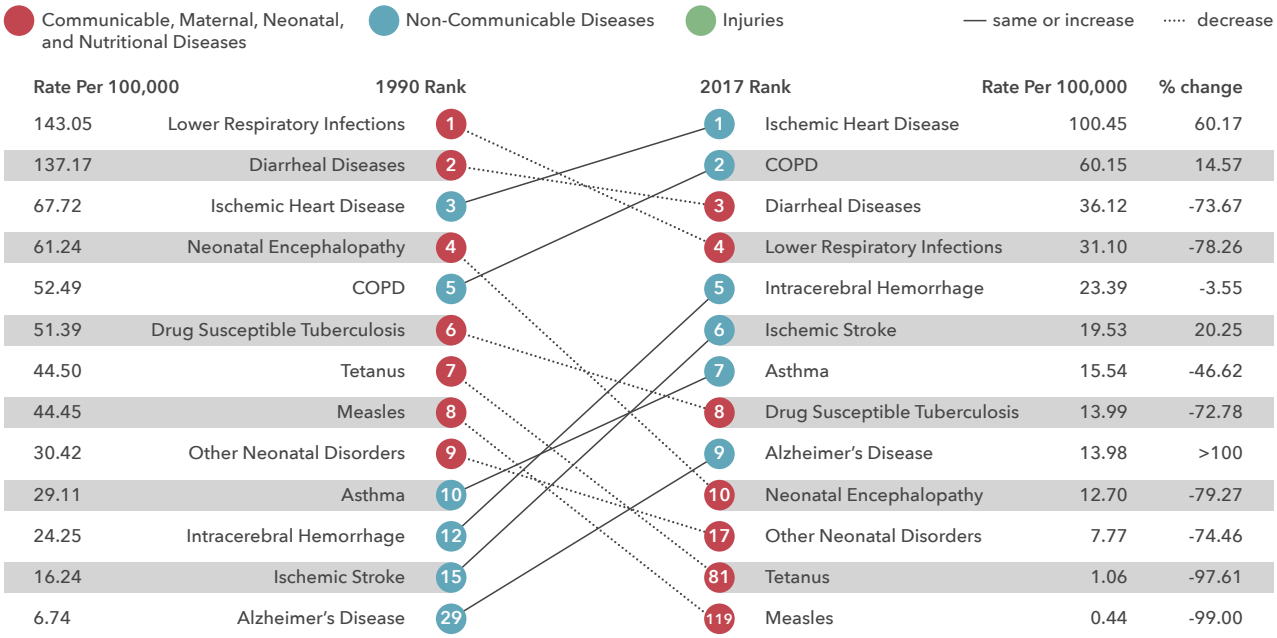
Figure 1: *Child mortality trend of Nepal between 1990 and 2017*

were 80.3 and 58.3 deaths per 1,000 live births, respectively. The observed under-5 and under-1 mortality rates were 31.4 and 27.2 deaths per 1,000 live births, respectively. The difference between under-5 expected and observed mortality rates is more than two-fold; Nepal's under-5 observed mortality rate is outperforming expectations.

Cause-specific mortality

A total of 182,751 deaths are estimated in Nepal for the year 2017. NCDs are the leading causes of death – two-thirds (66%) of deaths are due to NCDs, with an additional 9% due to injuries. The remaining 25% are due to CMNN diseases. Between 1990 and 2017, there were changes in the all age-ages, both sexes death rates in Nepal. Ischemic heart disease has a rate of 100.5 (95% UI: 86.0–114.0) deaths per 100,000 population and has the highest cause-specific death rate. Ischemic heart disease has been the leading cause for the last 16 years, starting from 2002, when the death rate was 65.8 (95% UI: 55.6–77.0) deaths per 100,000 population. Following ischemic heart disease, COPD (60.2, 95% UI: 49.1–76.7), diarrheal diseases (36.1, 95% UI: 19.7–53.1), lower respiratory infections (31.1, 95% UI: 25.9–36.5), intracerebral hemorrhage (23.4, 95% UI: 18.0–28.2), ischemic stroke (19.5, 95% UI: 15.2–24.0), asthma (15.6, 95% UI: 10.0–23.8), drug-susceptible tuberculosis (14.0, 95% UI: 8.9–19.5), Alzheimer's disease (14.0, 95% UI: 12.0–16.0), and neonatal encephalopathy (12.7, 95% UI: 9.3–16.4) round out the top 10 disease conditions as causes of deaths [see Figure 2]. Of the top 10 causes listed above, four causes are CMNN diseases (diarrheal diseases, lower respiratory infections, drug-susceptible tuberculosis, and neonatal encephalopathy), while the other six are NCDs.

The previous two decades have marked an epidemiological transition from communicable diseases to NCDs. The death rate due to communicable, maternal, neonatal, and nutritional diseases declined rapidly by 78% between 1990 and 2017; while the decline is sluggish at 18% and 20% for death rates due to NCDs and injuries, respectively.



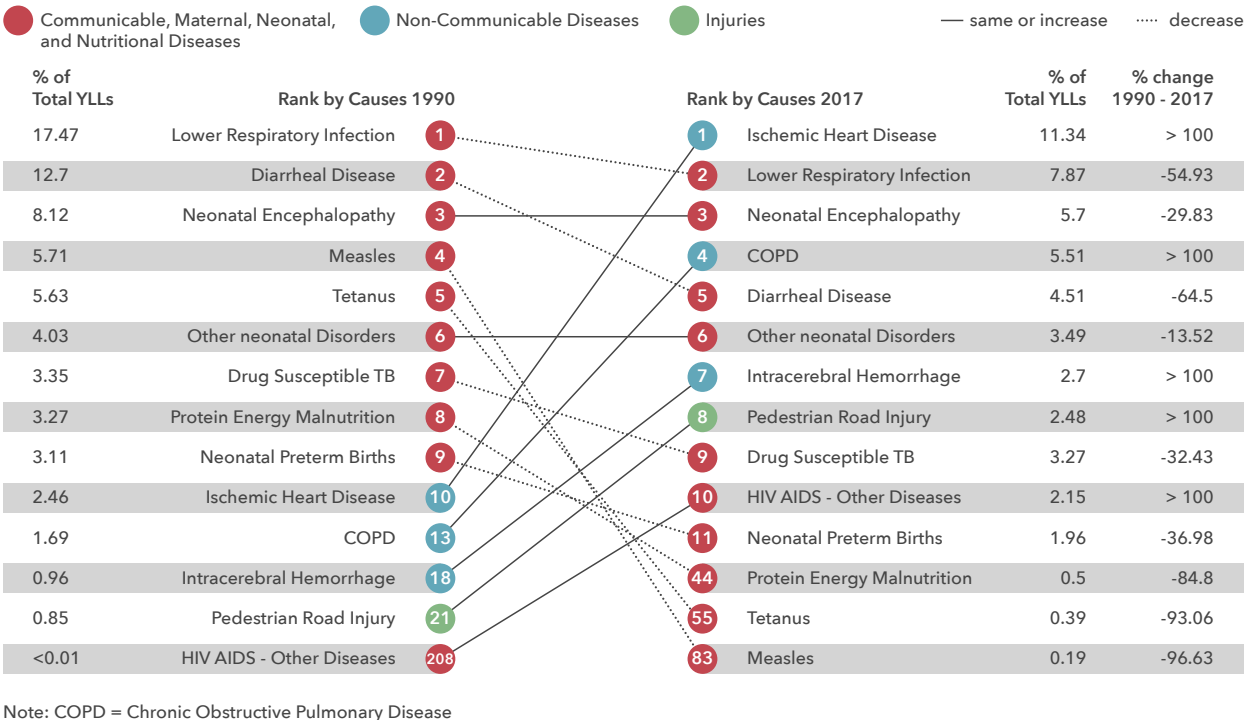
Note: COPD = Chronic Obstructive Pulmonary Disease

Figure 2: *Top 10 causes of deaths in Nepal by all-age per 100,000 population, for both sexes and percent change from 1990 to 2017*

In 2017, NCDs had a mortality rate of 404.2 (95% UI: 357.3–445.2) deaths per 100,000 population. The top three ranked NCDs in 2017 were ischemic heart disease, COPD, and intracerebral hemorrhage. The mortality rate for CMNN diseases dropped sharply from 698.2 (95% UI: 639.7–754.4) to 150.9 (95% UI: 124.6–186.0) deaths per 100,000 population between 1990 and 2017. Diarrheal diseases, lower respiratory infections, and drug-susceptible tuberculosis were the top three ranked communicable diseases in 1990 and 2017; however, the mortality rates declined by 74%, 78%, and 73%, respectively, for these diseases over the period. Injuries had a mortality rate of 56.3 (95% UI: 44.6–68.8) deaths per 100,000 population, decreasing from 70.0 (95% UI: 54.0–82.0) deaths per 100,000 population in 1990. The three top-ranked injuries in 2017 were pedestrian road injuries (12.0, 95% UI: 5.5–22.2), falls (9.7, 95% UI: 7.5–12.1), and self-harm by other specified means (7.3, 95% UI: 5.5–8.9). Drowning, pedestrian road injuries, and self-harm by other specified means were the top three ranked injuries in 1990.

Causes of premature death

The BoD study uses YLLs to count the burden of early death. YLLs quantify the number of years a person loses at the age of their death in comparison to a reference life expectancy. Out of the total (5,850,044) YLLs, 49% are due to NCDs, 39% due to CMNN diseases, and the remaining 12% due to injuries. The leading causes of YLLs are neonatal disorders (12.9% of total YLLs), ischemic heart disease (11.3% of total YLLs), lower respiratory infections (7.9% of total YLLs), and COPD (5.5% of total YLLs). While many of the top causes of premature death overlap with the top causes of death, the inherent weighting of diseases affecting younger populations in YLLs brings neonatal and communicable diseases to the forefront. Lower respiratory infections, neonatal encephalopathy, diarrheal diseases, and other neonatal disorders are still the second, third, fifth, and sixth leading causes of premature deaths in 2017, respectively. Thus, while these particular causes have substantially reduced their contribution to the total burden



Note: COPD = Chronic Obstructive Pulmonary Disease

Figure 3: *Top 10 causes of YLLs in Nepal by all-age, percentage of total YLLs for both sexes and percent change from 1990 to 2017*

due to premature death since 1990 [see Figure 3], communicable and neonatal conditions remain significant public health issues in Nepal. At the same time, the relative ranking of measles, tetanus, and protein-energy malnutrition by their YLLs rates has substantially decreased from top 10 ranking, whereas ischemic heart disease and COPD have skyrocketed in their ranking for premature death from 10th and 13th to first and fourth, respectively, since 1990. This illuminates both the increase in age-standardized[7] rates of NCDs and the demographic shift to an older population age structure.

Figure 4 shows how causes of premature deaths vary across different age groups in Nepal. While maternal and neonatal disorders and respiratory infections are leading causes of early death among infants, enteric infections and other infectious diseases are major causes of early death among children under 5. Injuries account for the majority of premature deaths among adolescents, whereas NCDs, such as cardiovascular diseases and COPD, contribute to most early deaths among adults aged 30 and above. These findings indicate age-specific differences in early deaths and thus suggest specific interventions targeting the specific age groups.

7 Age-standardization is a statistical technique used to compare populations with different age structures, in which the characteristics of the populations are statistically transformed to match those of a reference population. It is useful to compare age-dependent diseases (such as ischemic heart disease) or risk factors (such as occupational risks) across populations to overcome the variation caused by under- or over-representation of different age groups.

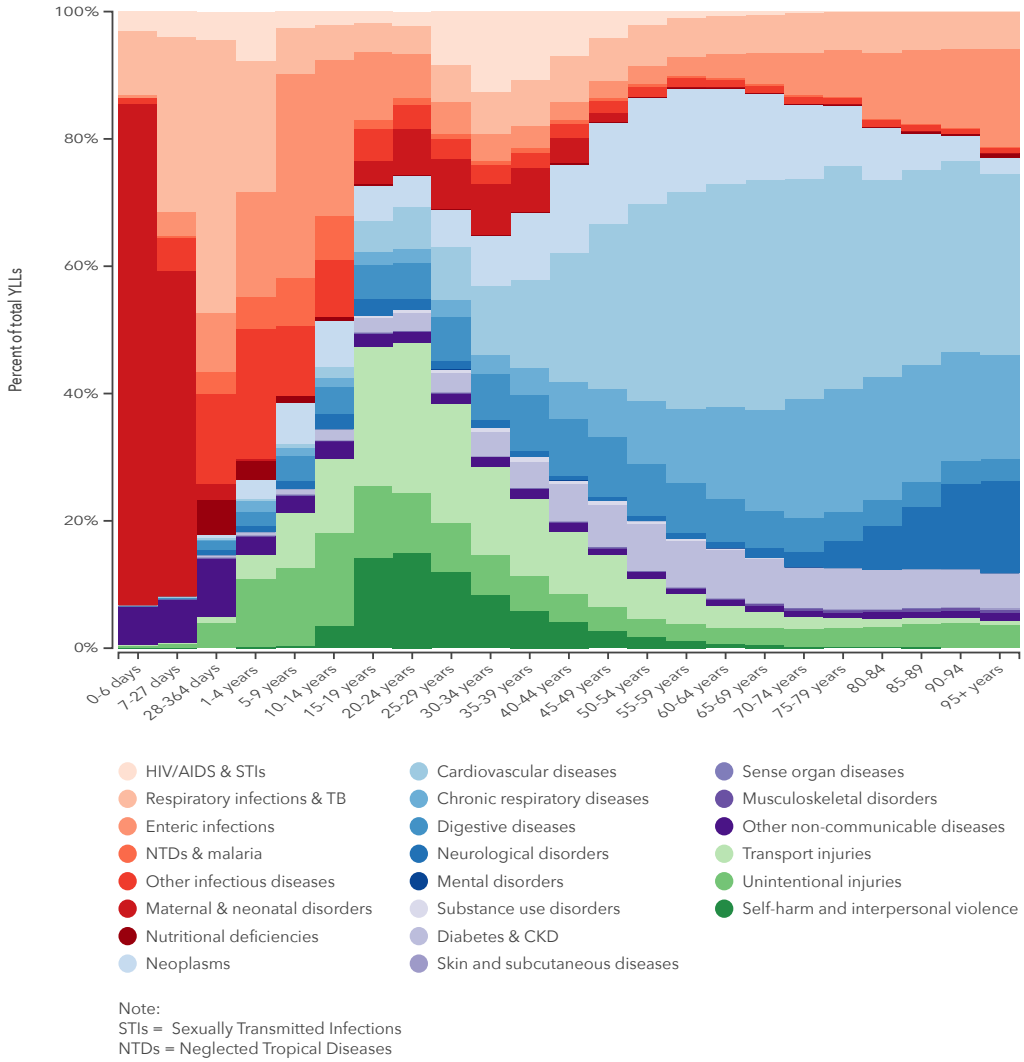


Figure 4: *Percentage breakdown of total premature deaths (YLLs) by age, both sexes, Nepal, 2017*

Causes of disability

The BoD study considers disability as any short- or long-term suffering from a disease or injury, taking their severity into account. The BoD 2017 results for Nepal highlight causes of disability due to nonfatal outcomes including chronic pain and mental conditions. Some fatal conditions, such as COPD and diabetes, also contribute substantially to disability due to their high prevalence[8]. Low back pain, migraine, COPD, and other musculoskeletal disorders are the leading causes of disability in 2017. Out of the total (3,165,276) YLDs in 2017, 77% are due to NCDs, 17% due to CMNN diseases, and the remaining 6% due to injuries. The number of years Nepalese spent

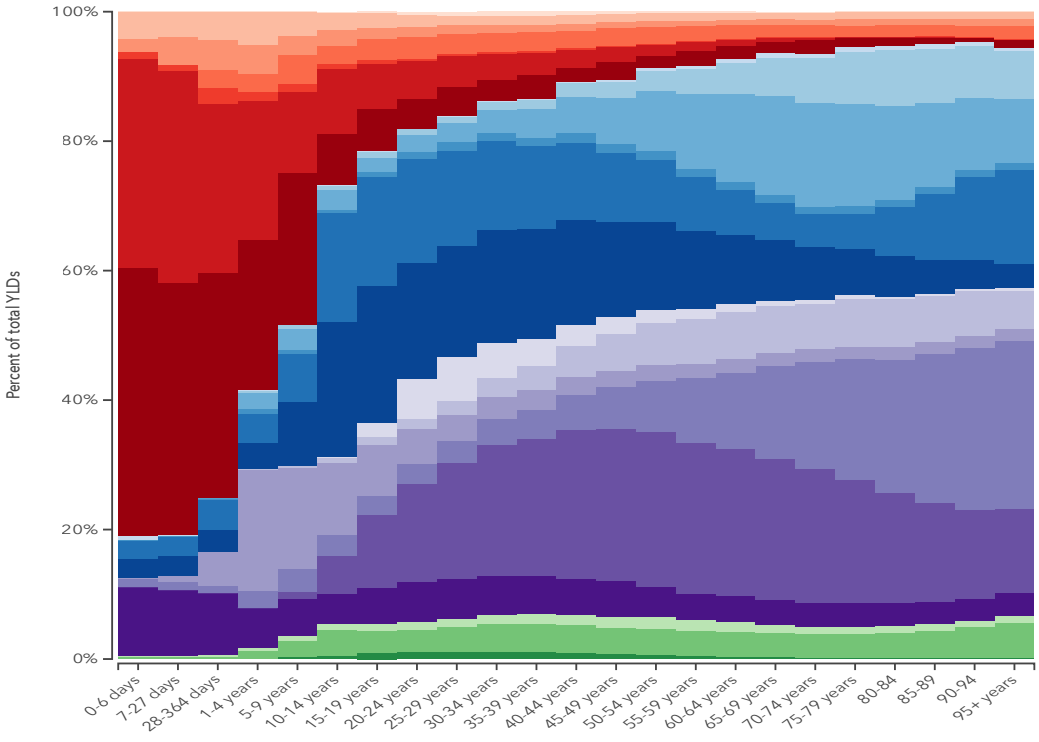
8 YLDs are calculated by multiplying the prevalence of disease with short- or long-term loss of health associated with the that disease (disability weight). YLDs are always the product of prevalence of disease and the disability weight. So YLDs and disease prevalence are directly proportional: the higher the prevalence of disease, the higher the YLDs, and vice versa.

Communicable, Maternal, Neonatal, and Nutritional Diseases | Non-Communicable Diseases | Injuries | same or increase | decrease

% of Total YLDs	Rank by Cause 1990		Rank by Cause 2017		% of Total YLDs	% change 1990 - 2017
12.11	Dietary Iron Deficiency	1	1	Low Back Pain	9.28	41.37
6.56	Low Back Pain	2	2	Migraine	8	22.03
6.55	Migraine	3	3	COPD	5.11	33.77
3.95	Other Musculoskeletal Disorders	4	4	Other Musculoskeletal Disorders	4.81	21.61
3.82	COPD	5	5	Dietary Iron Deficiency	4.2	-65.29
3.6	Vitamin A Deficiency	6	6	Major Depressive Disorder	3.96	26.29
3.13	Major Depressive Disorder	7	7	Age Related Hearing Loss	3.56	31.77
2.78	Anxiety Disorders	8	8	Anxiety Disorders	3.33	19.91
2.7	Age Related Hearing Loss	9	9	Diabetes Type II	3.1	68.17
2.61	Hookworm Diseases	10	10	Neonatal Preterm Birth	2.13	27.92
1.84	Diabetes Type II	13	25	Vitamin A Deficiency	1.01	-71.9
1.67	Neonatal Preterm Birth	14	36	Hookworm Diseases	0.63	-75.93

Note: COPD = Chronic Obstructive Pulmonary Disease

Figure 5: *Top 10 causes of YLDs in Nepal by all-age, percentage of total YLDs for both sexes and percent change from 1990 to 2017*



HIV/AIDS & STIs
Respiratory infections & TB
Enteric infections
NTDs & malaria
Other infectious diseases
Maternal & neonatal disorders
Nutritional deficiencies
Neoplasms
Cardiovascular diseases
Chronic respiratory diseases
Digestive diseases
Neurological disorders
Mental disorders
Substance use disorders
Diabetes & CKD
Skin and subcutaneous diseases
Sense organ diseases
Musculoskeletal disorders
Other non-communicable diseases
Transport injuries
Unintentional injuries
Self-harm and interpersonal violence

Note:
STIs = Sexually Transmitted Infections
NTDs = Neglected Tropical Diseases

Figure 6: *Percentage breakdown of total years lived with disability (YLDs) by age, both sexes, Nepal, 2017*

While the number of years Nepalese spent living with disability from chronic pain and mental disorders rose between 1990 and 2017, people living with disability due to communicable diseases and nutritional deficiencies dropped sharply. This trend might indicate effectiveness of maternal and child health interventions, but it has important implications for the health system, which must consider the growing number of NCD cases.

living with disability from NCDs (such as low back pain, migraine, and COPD) rose between 1990 and 2017, whereas disability due to conditions like dietary iron deficiency, vitamin A deficiency, and hookworm diseases dropped sharply [see Figure 5 with percentage change] in the period. This trend indicates the effectiveness of maternal and child health interventions, but it has important implications for the health system, which must adjust to the growing number of NCD cases.

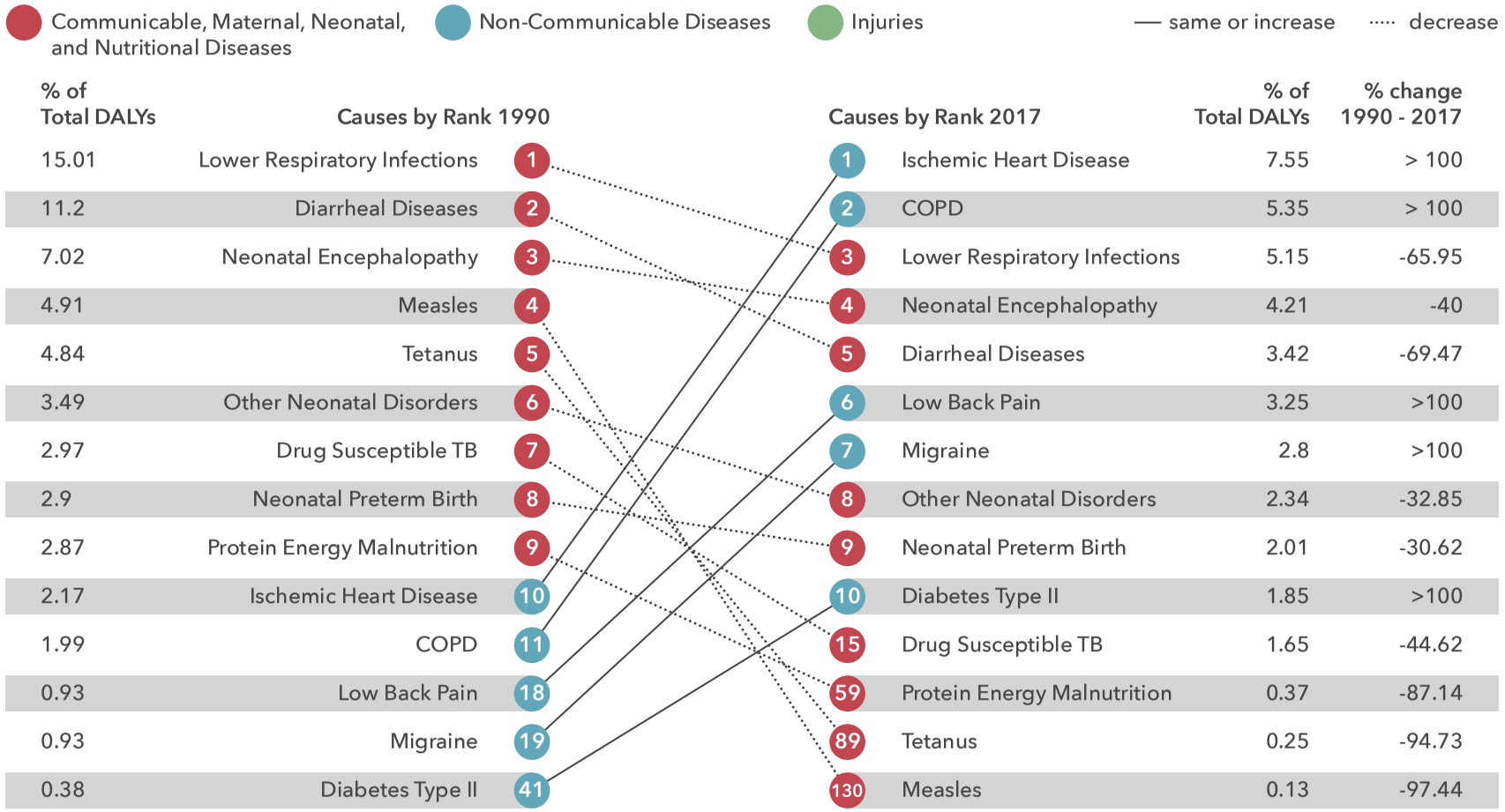
While disability due to diseases is most common among older people, children and adults are also affected. Figure 6 depicts causes of disability across the lifespan. Disability from nutritional deficiencies is a major problem among children under 5. Low back pain (as included in musculoskeletal disorders in the figure below), the leading cause of disability in Nepal, tends to affect middle-aged adults. COPD (as included in chronic respiratory diseases in the figure below) and sense-organ-related disability are common among the older population.

Burden of disease

The GBD study uses DALYs to measure overall burden of disease. DALYs compare the impact of different diseases and injuries by taking measures of early death (YLLs) and disability (YLDs) into account. DALYs allow comparisons of years lost from early death combined with years lived with disability. Out of the total (9,015,320) DALYs in 2017, 59% are due to NCDs, 31% due to CMNN diseases, and the remaining 10% due to injuries. Figure 7 illustrates this comparison of disease burden from different causes, revealing that ischemic heart disease and COPD were the most important health problems in the country in 2017. Figure 7 reflects progress achieved in tackling communicable diseases such as lower respiratory infections, and diarrheal diseases. For example, lower respiratory infections declined in rank from first to third, and diarrheal diseases from second to fifth between 1990 and 2017. Similarly, measles and tetanus fell sharply in rank, from fourth and fifth to 130th and 89th, respectively, between the periods. Figure 7 also highlights the importance of DALYs to understand a country's health problems. Diseases that tend to cause premature death, in contrast to those causing disability, were among the top 10 causes of disease burden. Almost all causes that have increased in rank are NCDs, and almost all that have decreased have been CMNN diseases. However, five out of the top 10 causes of disease burden are still CMNN diseases. Thus, while increasing attention must be given to NCDs, it is crucial that maternal and child health remain a high priority.

Five out of the top 10 causes of disease burden in 2017 are still CMNN diseases. Health system priorities thus need to balance these causes with the growing burden of NCDs.

The NBoD 2017 results exhibit some important gender differences in disease burden. Ischemic heart disease ranked higher in males (first) than in females (third), and COPD ranked higher in females (first) than in males (third). This result may be explained by the fact that females are more likely to be exposed to indoor air pollutants resulting from the use of solid biomass fuels (such as wood, crop residue, and dung) for cooking, whereas largely only smoking will impact males. Similarly, nonfatal outcomes like low back pain (fourth versus seventh) and migraine (seventh versus 11th) rank higher in females than in males. Figure 8 illustrates burden of disease from different causes across the lifespan. This information can be useful for tailoring age-group-specific health services and interventions. The trend of disease burden across different age groups is similar to age-specific causes of premature death described elsewhere in this report.



Note: COPD = Chronic Obstructive Pulmonary Disease

Figure 7: *Top 10 causes of DALYs in Nepal by all-age, percentage of total DALYs for both sexes and percent change from 1990 to 2017*

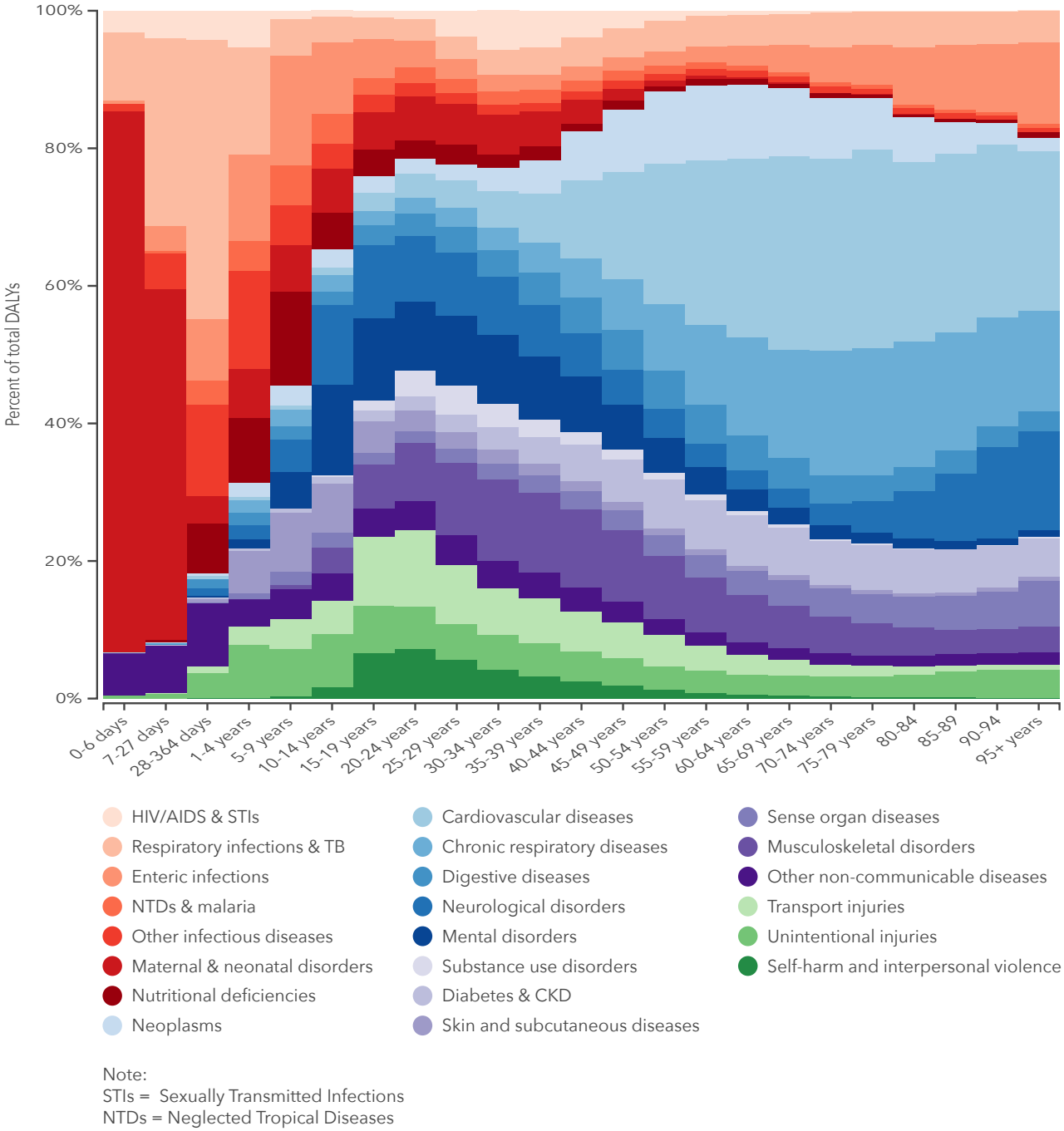


Figure 8: *Percentage breakdown of total disease burden (DALYs) by age, both sexes, Nepal, 2017*

Risk factors: preventing disease burden

Risk factors are the key drivers of injuries and diseases that cause burden. The GBD 2017 study, and therefore the NBoD 2017 report, categorizes risk factors into three different categories; behavioral, environmental/occupational, and metabolic risk factors. Much of Nepal's disease burden could be reduced by addressing these risk factors. Approximately, 34% of the total disease burden (DALYs) could potentially be

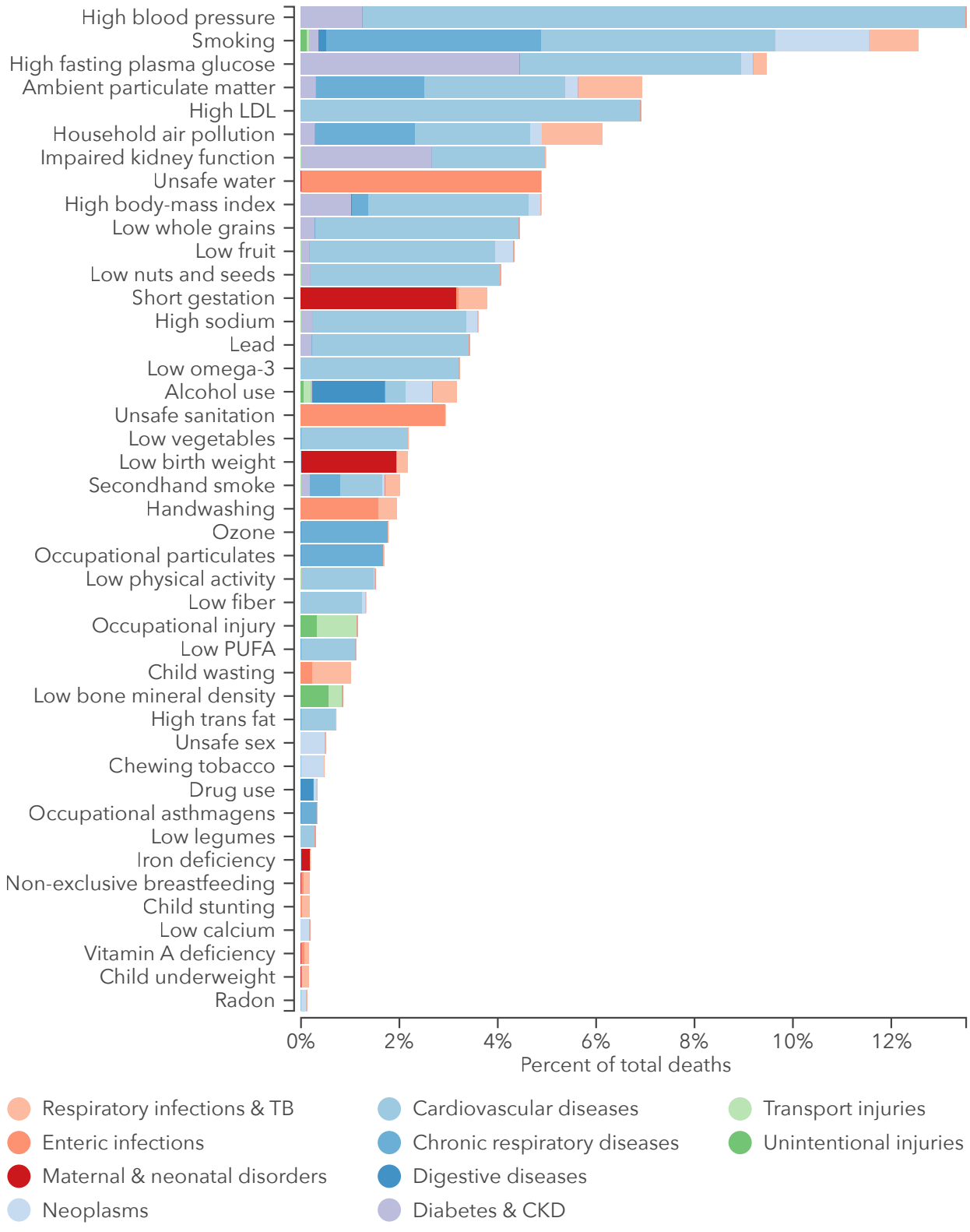


Figure 9: *Percentage of deaths attributable to risk factors for Nepal, all-ages, both sexes, 2017*

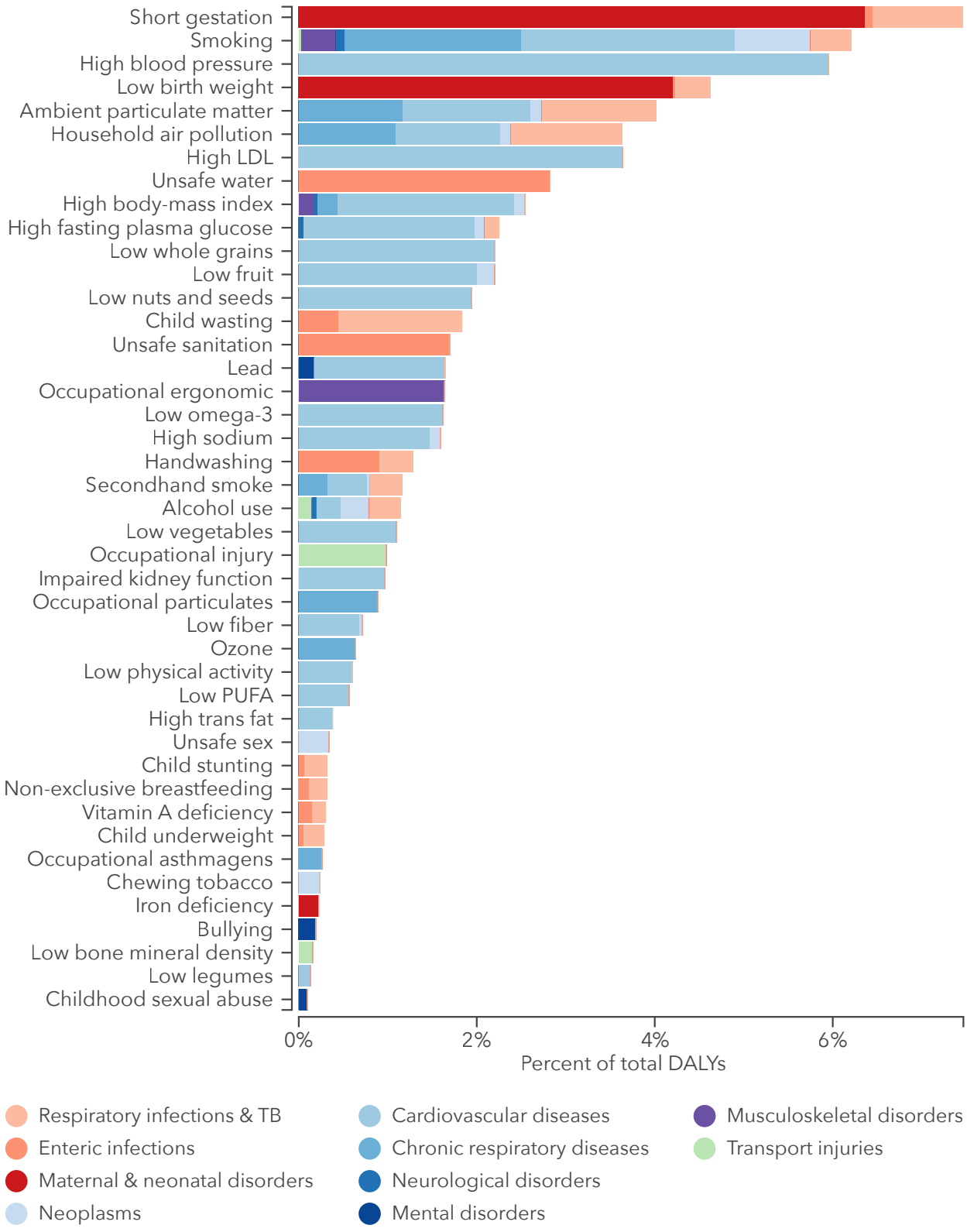


Figure 10: *Percentage of DALYs attributable to risk factors for Nepal, all-ages, both sexes, 2017*

averted by addressing behavioral risks factors, 18% by addressing environmental/occupational risks, and 14% by addressing metabolic risk. While ischemic heart disease is the major cause of death in Nepal; it is evident that high systolic blood pressure, smoking, high blood glucose levels, and ambient air pollution are the top five leading risk factors for death (Figure 9). Almost 14% of deaths are attributable to high systolic blood pressure, 13% to smoking, 10% to high blood glucose levels, and 7% to ambient air pollution. The top five risks contributing to DALYs are short gestation, high systolic blood pressure, smoking, high fasting plasma glucose, and low birth weight, thus suggesting prioritization of these factors in addressing Nepal's health problems.

While ischemic heart disease is the major cause of death in Nepal, it is no surprise that high systolic blood pressure, smoking, high blood glucose levels, and ambient air pollution are the top five leading risk factors for death.

In 2017, high systolic blood pressure was the major metabolic risk factor contributing to disease burden (7% of total DALYs), particularly the burden of cardiovascular diseases (6% of total DALYs). Similarly, high rates are observed for high fasting blood glucose (Figure 10). The all-cause attributable disease burden for high blood glucose was 5%, which has increased dramatically from 1% in 1990. High blood glucose levels alone contributed to 2% of disease burden from cardiovascular diseases. Preterm birth complications, smoking, and low birth weight are the top three behavioral risk factors, contributing to 8%, 7%, and 5% of the total disease burden, respectively. These risk factors are responsible for higher burden of maternal and neonatal disorders in females and cardiovascular diseases in males. Ambient particulate matter pollution, a major environmental risk factor, presents a serious challenge to the health and well-being of the Nepalese population. It is a major contributor to chronic respiratory diseases, cardiovascular diseases, and lower respiratory infections. Nepal could avert 7% of total deaths, 6% of total early deaths, and 4% of total disease burden by reducing ambient particulate matter pollution.

Understanding the risk factors that are most problematic in different age groups helps determine areas where the biggest health improvements are needed in every age group. For example, 21% of premature death and 21% of total disease are burden among childre nunder 5. Similarly, systolic blood pressure accounts for 20% of early deaths and 15% of overall disease burden in adults aged 50 to 69 year-old. These findings indicate a need for reducing low birth weight in children and addressing high systolic blood pressure in the elderly population. Although smoking and exposure to particulate matter pollution are the leading causes of death in later life, it is cumulative exposure to these risks over the period of a lifetime that causes the deaths. Preventing exposure to risk factors from early childhood thus increases the life expectancy of the Nepalese population.

Implications for policy and programme

This report has used GBD 2017 results to illustrate the overall country BoD in terms of mortality and morbidity by major diseases and risk factors. The report has revealed an overall decline in the burden of communicable diseases, but with an increasing burden due to NCDs between 1990 and 2017. The change in disease pattern is vastly different from the trend that existed during the 1990s. The transition will have important implications not only for health policy and planning, but also in the wider context of education, trade, social welfare, food regulations, transport, and the environment – both as causes and effects of the NCDs epidemic.

Demographic shift to ageing population

The results in this NBoD 2017 report have revealed an increase in average life expectancy of 12.6 years and a decrease in under-5 mortality by 103.0 per 1,000 live births between 1990 and 2017. The increasing life expectancy, declining mortality rates, and increasing burden of NCDs indicates a demographic shift to an aging population, which will have major health and social policy implications. As the proportion of the elderly increases, the health system will face new challenges. The rapid growth of an older population will have a major impact on prevalence of chronic conditions, specifically due to NCDs, sensory impairment, and musculoskeletal disorders (14, 15). Demand for medical services will generally be higher for older individuals compared to their younger counterparts. The health system will need to cope with increasing demand for health care services on one hand and promote healthy behavior across the life course on the other hand (14). The aging population will also create socioeconomic impacts such as a stretched labor market and loss to national production, demand for social security schemes like pensions, and changes in family composition (15). Nepal's development policies will need to ensure resources and arrange strategies to address this transition.

Achievements in communicable diseases

The NBoD 2017 report demonstrates clear evidence of significant progress in reducing the burden of communicable diseases. These diseases were the leading causes of mortality and morbidity until 2000, at which point their overall health impacts started to decline. The declining burden of communicable diseases may be attributable in part to disease-specific priority health interventions such as the Malaria Control Program. Although the overall burden of communicable diseases is decreasing, emerging infections (such as dengue, scrub typhus and influenza) and sporadic outbreaks of epidemic diseases and infections due to antimicrobial resistance are posing new public health threats in recent years (16, 17). Disease prevention programmes should therefore focus on strengthening the surveillance system and early detection of outbreaks to prevent the public health threats of emerging diseases (18). The focus of funding may also need to be expanded to address these less discussed but important diseases (16).

Improvements in maternal and child health

Compared to 1990, maternal, neonatal, and childhood diseases have declined in the overall BoD ranking by 2017. This decline in ranking, together with declining under-5 mortality rates, indicates an improving maternal and child health situation during the period between 1990 and 2017. The health impact of vaccine-preventable diseases like measles and tetanus has sharply declined, and the burdens of lower respiratory infections and diarrheal diseases are declining gradually. The overall achievement in maternal and child health outcomes is attributable to successful implementation of prevention programs such as immunization against vaccine-preventable diseases, the safe motherhood programme, and community-based interventions for diarrheal diseases and acute respiratory infections (19, 20). Despite the decline in disease burden, however, maternal, neonatal, and child health issues remain a significant public health concern in Nepal. Rates for maternal and neonatal mortality are still high when compared to the SDGs targets for Nepal (21). CMNN diseases are still among the top causes of BoD in 2017, illustrating the need for further policy attention. Efforts should be made towards investment in strategies to improve the quality of maternal and child health services from equity perspective (22).

Rising NCDs epidemic

From results in this NBoD 2017 report, it is observed that NCDs are an increasingly important contribution to the BoD in Nepal. Nepal is rapidly moving toward becoming a middle-income country, and as part of this transition the age structure of the population, income distribution, nutritional and personal behaviours, and living standards are changing (23, 24). This is reflected in changes in the population health landscape from infectious to NCD epidemic. While NCDs are increasing, an integrated and multi-sectoral approach is needed for their prevention, treatment, and rehabilitation (25, 26). It is encouraging that the Government of Nepal has introduced the NCDs Multi-Sectoral Action Plan (2014–2020) to respond to the NCD epidemic through multi-sectoral partnerships (27). However, implementation of the action plan is not fully institutionalized. Nepal needs to build NCD programmes focusing on the devolved health system (28). Health facilities need to be prepared for the demand of care that NCDs will require. This involves provision of integrated preventive and promotive services at the local level and coordination between local and higher-level health facilities to provide curative services (25, 29).

Federalism and GBD results

This first country report on BoD, based on GBD results, comes at a critical time. Under the new Federal Constitution, provinces and local governments are to take up the responsibility of managing their own health services: setting their own priorities, allocating the resources, and monitoring how they perform – all to suit their own local situation. They are having to decide whether, and how much, they need to invest in curative care and building facilities, in prevention, in multi-sectoral engagement with Water, Sanitation, and Hygiene, programs, and in Safe Motherhood. In other words, policymakers are being required to make trade-offs between policy decisions such as whether maternal health services, immunisation, and family planning services should be the priority. The report does not tell us much about BoD at the subnational level, but it hints at some of the priorities and their implications at the local level. The long-term goal should be to obtain and present the subnational data to allow for performance assessment and better policy choice. Efforts should also be directed toward refining the BoD estimates for Nepal by feeding the available data into upcoming GBD studies.

Filling the data gap: refining the BoD estimates for Nepal

The GBD study systematically identifies and uses data from multiple sources including published and unpublished sources. Published scientific literature can be a good source for some conditions, such as epilepsy, but for many other conditions, unpublished data sources such as vital registration, hospital discharge records, surveys, disease registries and surveillance data are equally important. Although use of data

from diverse sources is preferred for robust and reliable BoD estimates, data sources in Nepal are fairly limited to censuses, periodic surveys and epidemiological surveillance systems. Mortality estimates, for instance, are generally informed by large household surveys (such as NDHS) and census data with specific focus on under-5 mortality but limited scope for adult all-causes mortality (5). Generating cause-specific mortality estimates for Nepal is challenging due to the lack of a functioning civil registration and vital statistics (CRVS) system in Nepal that could gather complete and reliable information on causes of death (30). Verbal autopsy studies have been used as a primary alternative to gather causes of death in Nepal, but they are mainly focused on specific demographic groups such as mothers and children (5). The recent NDHS studies included verbal autopsy components but focused on maternal and neonatal deaths. MoHP has initiated community-based verbal autopsy in three pilot districts to identify causes of death at the household level, and is strengthening the capacity of hospitals to provide medical certification of causes of death to better record causes of deaths occurring in hospitals. These initiatives are yet to be institutionalised for obtaining initial results. HMIS data are the major sources for outpatient and inpatient morbidity data. HMIS captures out patient data mainly from public health facilities. However, these data are limited in scope, coverage and quality. Moreover, HMIS data have not been able to capture inpatient morbidity across all health facilities in the country (5). Improving the quality and coverage of HMIS will help to gather better morbidity data and hence refine BoD estimates for Nepal. Risk factor estimates for Nepal are predominantly obtained from large household surveys, but they are confined to risk factors associated with childhood disorders, infections, maternal outcomes, and NCDs. Obtaining the refined BoD estimates for Nepal requires concentrated efforts in the areas highlighted below.

- Strengthen current initiatives of community verbal autopsy and hospital-based medical certification of cause of death. Extend CRVS system to the local level, building on the current efforts of community verbal autopsy.
- Strengthen HMIS in terms of coverage, quality and scope of data, such as dual coding system for injuries data.
- Standalone surveys for disease/health conditions such as COPD; mental disorders; musculoskeletal conditions including low back pain, neck pain, and arthritis; migraine; and sense organ diseases.
- Gather information on additional risk factors such as air pollution and behavioural risk factors through large household surveys.
- Strengthen hospital-based cancer registry and population-based cancer registry in terms of coverage and quality.
- Collate ambient air pollution (especially PM2.5) data and make them available for feeding into upcoming GBD estimates.
- Utilise any opportunities to capture air pollution data in terms of wider geography and time period.
- Collate and utilise the data on homicides, suicides, and road traffic injuries that are maintained in the Nepal Police database.

Conclusion

This report has extracted and summarized data from the GBD 2017 Study to present Nepal's health status in terms of overall mortality, causes of mortality, causes of morbidity and risk factors. The NBoD has revealed increasing life expectancy over the past two decades. The study findings suggest the changing nature of premature mortality: for instance, premature mortality due to several NCDs, specifically ischemic heart disease and COPD, rose in recent years, whereas premature death due to communicable diseases declined dramatically. The increasing life expectancy as well as the burden of NCDs signal a demographic shift to an ageing population. This shift could have significant implications for resource allocation in the Nepalese health system. Although the burden of CMNN diseases has declined, these diseases are still among the leading causes of mortality and morbidity. Investment in maternal and child health services from an equity perspective is likely to improve the health status of Nepalese women and children. Analysis of risk factors suggests the predominance of modifiable risk factors is driving the major causes of disease burden. Prioritization of modifiable risk factors could reduce avoidable mortality in the coming years. The findings of this study are confined to identifying health priorities at the national level. This has raised the need for producing BoD estimates at sub-national and local levels. The long-term efforts should thus be on generating reliable and quality data at the federal, provincial and local levels.

Ways forward

We suggest following steps for refining the BoD estimates for Nepal at federal, provincial, and local level:

- Explore and utilize available national, and local-level data to feed into the next cycles of GBD results produced by IHME.
- Strengthen verbal autopsy and CRVS system to generate local level data on mortality.
- Strengthen the disease registries such as population-based cancer registry and initiate other disease registries to enhance the availability of local data on morbidity and mortality.
- Develop/improve data sharing policy and refine GBD estimates for Nepal.
- Gradually move toward sub-national estimates and local burden of disease.
- Build capacity on understanding, accessing, and using BoD estimates.
- Use GBD estimates to measure progress in SDG-related health indicators as well as in Annual Work Planning and Budgeting of the MoHP.

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Annex

Annex 1: Major sources of data from Nepal used in GBD 2017 study

Annex Table 1; Major sources of data from Nepal used in the GBD 2017 study

Data source	Contributor	Time period	Data coverage
Survey			
Nepal Demographic and Health Survey	Ministry of Health and Population	1996, 2001, 2006, 2011, 2016	National
Rapid Assessment of Avoidable Blindness	International Centre for Eye Health	2016, 2010, 2009, 2008	Conducted at different phase at sub national level (Narayani, Dhaulagari, Rapti, Mechi, Bheri, Koshi, Sagarmatha, Janakpur Karnali)
Multiple Indicator Cluster Survey	Central Bureau of Statistics	2010, 2014, 1995–1998	National
Nepal National Headache Survey	Dhulikhel Hospital	2015	National
Nepal STEPS Non-Communicable Risk Factor Survey	World Health Organization	2013, 2007, 2005, 2003	National
Nepal Polio Campaign Monitoring Report	Global Polio Eradication Initiative	2010, 2011	National
Nepal Mapping and Size Estimation of Most At-Risk Populations	National Centre for AIDS and STD Control	2011	National
Nepal Global Youth Tobacco Survey	World Health Organization	2007, 2011, 2004, 2001	National
Nepal Living Standard Survey	Central Bureau of Statistics	2011, 2004, 1996	National
Nepal - Bhaktapur Malnutrition and Enteric Disease Study	Institute of Medicine, Tribhuvan University	2009–2014	Subnational
Nepal Immunization Coverage Survey	Ministry of Health and Population	2009	National
Nepal Maternal Mortality and Morbidity Study	Ministry of Health and Population	2009	Subnational (Bheri, Bāgmati, Dhawalagiri, Karnali, Kosi, Lumbini, Seti)
Chronic Kidney Disease and Cardiovascular Risk Survey 2006–2011	International Society of Nephrology	2006–2011	Subnational (Koshi)
Nepal Hard Drug User Survey	Central Bureau of Statistics	2007	National

Data source	Contributor	Time period	Data coverage
Nepal Status of Reproductive Morbidities	United Nations Population Fund (UNFPA)	2006	Subnational (Dhawalagiri, Janakpur, Karnali, Lumbini, Mahakali, Narayani, Rapti, Sagarmatha)
Nepal Iodine Deficiency Disorders Status Survey	Ministry of Health and Population	2005	National
WHO Global Survey on Maternal and Perinatal Health	World Health Organization	2004–2008	Health Facility survey in 23 countries including Nepal
Nepal World Health Survey 2003	World Health Organization	2003	National
Nepal Intercensal Household Information Monitoring and Evaluation System	Central Bureau of Statistics	2000	National
Nepal Behavioral Surveillance Survey	Family Health International	1998–2003	Conducted in different phases at National and Sub National Level
Nepal Micronutrient Status Survey	Ministry of Health and Population	1997	National
Chitwan Valley Family Study	Institute for Social Research, University of Michigan	1996–1997	Subnational (Chitwan)
Rapti Adolescent Girls Nutrition Status Survey	New ERA. Nepal	1993	Subnational (Rapti)
Nepal Fertility, Family Planning Survey	Ministry of Health and Population	1986, 1992	National
Nepal In Depth Demographic and Health Survey	New ERA	1987	National
Nepal World Fertility Survey	Ministry of Health and Population	1976	National
Nepal Nutrition Status Survey	Centers for Disease Control and Prevention	1975	National
Nepal Demographic Sample Survey	United Nations Population Fund	1974–1975	National
Nepal World Poll	Gallup World Poll	2017–2005	National
Administrative record			
Nepal Hospital Inpatient Discharges Record	Department of Health Services, MoHP	2010–2012	National
WHO South East Asia Regional Neonatal-Perinatal Database Report	World Health Organization	2008	Six South East Asian countries including Nepal
Control of Epidemic Meningococcal Disease, WHO Practical Guidelines	World Health Organization	1970–1996	National level data for more than 40 countries including Nepal
Epidemiological records			
WHO Global Health Observatory Interactive Graph - Number of Cases of Cutaneous and Visceral Leishmaniasis	World Health Organization	1998–2015	Global Data including for Nepal
Reported Cases and Deaths of Dengue	World Health Organization Regional Office for South-East Asia (SEARO)	2003–2012	National level data for ten countries including Nepal
Nepal WHO Leishmaniasis Country Profile	World Health Organization	1994–2014	National Level

Data source	Contributor	Time period	Data coverage
Progress towards the elimination of leprosy as a public health problem	World Health Organization	1989–1993	National-level data for 24 countries including Nepal
Malaria 1982–1997. WHO Wkly Epidemiol Rec	World Health Organization	1982–1997	National-level data for more than 50 countries including Nepal
Census			
Nepal Population and Housing Census	Central Bureau of Statistics	1971–2011	National
Disease Registry			
Kidney Disease Data Center	International Society of Nephrology	2006–2009	National-level data for nine countries including Nepal
Other sources			
Population Living in Trachoma Endemic Areas	World Health Organization	2005–2018	National-level data for more than 50 countries including Nepal
Armed Conflict Location and Event Dataset	Strauss Centre for International Security and Law	1997–2018	National-level data for more than 50 countries including Nepal
Modell's Haemoglobinopathologist's Almanac	Centre for Health Informatics and Multiprofessional Education, University College London	1990–2003	National-level data for more than 50 countries including Nepal
Asia Air Quality Annual PM10 Averages	Clean Air Asia	2005–2012	National-level data from Asian countries including Nepal
Data Availability Among MARPs Prevalence and Population Size	Global Fund to Fight AIDS, Tuberculosis and Malaria	1995–2012	National-level data from South East Asia including Nepal

Annex 2: Additional tables on NBoD 2017 results

Annex Table 2: Causes of death 1990 and 2017, all ages, both sexes

Deaths per 100,000 in 1990		Causes of death	Deaths per 100,000 in 2017	
		Major causes		
(52.56, 73.57)	67.72	Ischemic heart disease	100.45	(86.01, 113.95)
(37.62, 75.94)	52.49	COPD	60.15	(49.10, 76.70)
(97.99, 180.51)	137.17	Diarrheal diseases	36.12	(19.65, 53.08)
(117.60, 167.22)	143.05	Lower respiratory infections	31.10	(25.93, 36.46)
(17.89, 30.88)	24.25	Intracerebral hemorrhage	23.39	(18.03, 28.17)
(12.21, 20.93)	16.24	Ischemic stroke	19.53	(15.17, 23.96)
(16.66, 41.10)	29.11	Asthma	15.54	(9.95, 23.80)
(31.23, 70.63)	51.39	Drug-susceptible tuberculosis	13.99	(8.87, 19.50)
(5.71, 7.82)	6.74	Alzheimer's disease	13.98	(12.06, 15.95)
(41.07, 84.64)	61.24	Neonatal encephalopathy	12.70	(9.29, 16.64)
		Broad causes		
(639.73, 754.40)	698.22	CMNN	150.86	(124.45, 185.94)
(303.24, 383.37)	342.03	Non-communicable diseases	404.22	(357.26, 445.16)
(54.02, 82.90)	70.03	Injuries	56.31	(44.57, 68.84)

Annex Table 3: Causes of premature death, 1990 and 2017, all ages, both sexes

% of YLLs in 1990 (YLLs = 12,827,874.92)		Causes of premature death	% of YLLs in 2017 (YLLs = 5,850,043.99)	
		Major causes		
(2.06, 2.88)	2.46	Ischemic heart disease	11.34	(9.71, 12.87)
(14.25, 20.52)	17.47	Lower respiratory infections	7.87	(6.42, 9.52)
(5.59, 11.08)	8.12	Neonatal encephalopathy	5.70	(4.28, 7.21)
(1.16, 2.52)	1.69	COPD	5.51	(4.35, 7.25)
(9.09, 17.23)	12.70	Diarrheal diseases	4.51	(2.77, 6.19)
(2.51, 5.81)	4.03	Other neonatal disorders	3.49	(2.44, 4.96)
(0.71, 1.21)	0.96	Intracerebral hemorrhage	2.70	(2.14, 3.24)
(0.53, 1.23)	0.85	Pedestrian road injury	2.48	(1.13, 4.67)
(2.20, 4.42)	3.35	Drug-susceptible TB	2.27	(1.47, 3.15)
(0.00, 0.00)	0.00	HIV/AIDS resulting in other diseases	2.15	(0.01, 11.52)
(1.96, 4.95)	3.11	Neonatal preterm births	1.96	(1.14, 3.45)
(2.15, 4.56)	3.27	Protein-energy malnutrition	0.50	(0.31, 0.73)
(3.26, 9.10)	5.63	Tetanus	0.39	(0.17, 0.97)
(2.05, 12.49)	5.71	Measles	0.19	(0.06, 0.46)
		Broad category		
(75.25, 81.56)	78.05	CMNN	39.26	(34.35, 47.36)
(13.71, 17.63)	15.77	Non-communicable diseases	48.51	(42.60, 52.69)
(4.57, 7.43)	6.17	Injuries	12.23	(9.4, 15.28)

Annex Table 4: Causes of disability, 1990 and 2017, all ages, both sexes

% of YLDs in 1990 (YLDs = 2,124,265.88)		Causes of disability	% of YLDs in 2017 (YLDs = 3,165,276.37)	
		Major causes		
(5.55, 7.68)	6.56	Low back pain	9.28	(8.08, 10.64)
(4.48, 9.03)	6.55	Migraine	8.00	(5.61, 10.65)
(2.83, 4.98)	3.82	COPD	5.11	(3.87, 6.46)
(3.02, 5.07)	3.95	Other musculoskeletal disorders	4.81	(3.71, 6.03)
(9.76, 14.38)	12.11	Dietary iron deficiency	4.20	(2.91, 5.94)
(2.38, 3.96)	3.13	Major depressive disorder	3.96	(3.12, 4.96)
(2.24, 3.27)	2.70	Age-related hearing loss	3.56	(2.85, 4.50)
(2.19, 3.45)	2.78	Anxiety disorders	3.33	(2.71, 4.07)
(1.55, 2.19)	1.84	Diabetes type 2	3.10	(2.61, 3.64)
(1.12, 2.36)	1.67	Neonatal preterm birth	2.13	(1.43, 3.08)
(2.69, 4.69)	3.60	Vitamin A deficiency	1.01	(0.62, 1.52)
(1.79, 3.59)	2.61	Hookworm diseases	0.63	(0.36, 0.98)
		Broad category		
(28.54, 35.92)	32.30	CMNN	16.75	(14.49, 19.63)
(60.01, 66.99)	63.46	Non-communicable diseases	77.49	(74.57, 79.87)
(3.91, 4.58)	4.24	Injuries	5.76	(5.41, 6.16)

Annex Table 5: Causes of disease burden, 1990 and 2017, all ages, both sexes

% of DALYs in 1990 (DALYs = 14,952,140.8)		Causes of disease burden	% of DALYs in 2017 (DALYs = 9,015,320.36)	
(1.82, 2.53)	2.17	Ischemic heart disease	7.55	(6.27, 8.73)
(1.51, 2.73)	1.99	COPD	5.35	(4.50, 6.54)
(12.31, 17.82)	15.01	Lower respiratory infections	5.15	(4.05, 6.53)
(4.80, 9.60)	7.02	Neonatal encephalopathy	4.21	(3.23, 5.36)
(8.09, 14.98)	11.20	Diarrheal diseases	3.42	(2.27, 4.67)
(0.69, 1.20)	0.93	Low back pain	3.25	(2.53, 4.12)
(0.59, 1.29)	0.93	Migraine	2.80	(1.87, 3.94)
(2.15, 5.04)	3.49	Other neonatal disorders	2.34	(1.62, 3.39)
(1.92, 4.47)	2.90	Neonatal preterm birth	2.01	(1.39, 3.08)
(0.29, 0.47)	0.38	Diabetes type 2	1.85	(1.55, 2.16)
(1.98, 3.91)	2.97	Drug-susceptible TB	1.65	(1.11, 2.23)
(1.92, 4.02	2.87	Protein-energy malnutrition	0.37	(0.24, 0.53)
(2.78, 7.86)	4.84	Tetanus	0.25	(0.11, 0.62)
(1.76, 10.75)	4.91	Measles	0.13	(0.04, 0.31)
		Broad category		
(68.80, 74.76)	71.58	CMNN	31.39	(27.69, 36.65)
(20.27, 24.77)	22.53	Non-communicable diseases	58.65	(54.35, 62.20)
(4.52, 6.98)	5.9	Injuries	9.97	(8.14, 11.93)

Annex Table 6: Major risk factors contributing todeath in 1990 and 2017, all ages,both sexes

% of death attributablerisk 1990 (Risk-related death = 136,584.29)		Risk factors for death	% of death attributable to risk 2017 (Risk-related death = 114,525.04)	
		Major risk factors		
(4.91, 6.92)	5.87	High systolic blood pressure	13.52	(11.44, 15.73)
(6.02, 8.47)	7.19	Smoking	12.89	(10.98, 14.67)
(2.53, 3.82)	3.11	High fasting plasma glucose	9.68	(7.90, 12.08)
(1.31, 4.93)	2.91	Ambient particulate matter pollution	6.93	(4.00, 10.07)
(1.89, 3.15)	2.45	High LDL cholesterol	6.90	(5.31, 8.72)
(6.95, 11.92)	9.43	Household air pollution	6.12	(4.12, 8.47)
(0.18, 1.62)	0.72	High body massindex	5.00	(2.41, 8.13)
(1.71, 2.29)	1.98	Impaired kidney function	4.97	(4.33, 5.63)
(6.51, 14.53	10.53	Unsafe water source	4.89	(2.40, 7.59)
(1.23, 2.71)	1.89	Diet low in whole grain	4.44	(2.79, 6.41)
(8.74, 14.50)	11.55	Short gestation for birth weight	3.81	(2.96, 4.71)
(5.62, 10.94)	8.24	Unsafe sanitation	2.94	(1.55, 4.28)
(4.28, 7.28)	5.69	Low birth weight for gestation	2.19	(1.68, 2.79)
(3.14, 8.61)	5.69	No access to hand washing	1.94	(0.97, 3.30)
(11.28, 18.92)	14.74	Child wasting	1.24	(0.72, 1.89)
(5.24, 10.33)	7.55	Child underweight	0.38	(0.24, 0.60)
		Broad category		
(45.11, 52.27)	48.97	Behavioral risks	39.64	(36.89, 46.22)
(23.73, 38.91)	28.28	Environmental/occupational risks	25.04	(22.31, 27.92)
(8.66, 11.55)	9.97	Metabolic risks	26.13	(22.93, 29.39)

Annex Table 7: DALYs Attributable to risk factors, 1990 and 2017, all ages,both sexes

% Attributable DALYs 1990 Risk-related DALYs = 9,074,601.07		Risk factors for DALYs	% Attributable DALYs in 2017 Risk-related DALYs = 4,463,150.16	
		Major risk factors		
(11.26, 18.49)	14.84	Short gestation for birth weight	7.52	(6.09, 9.03)
(1.95, 2.83)	2.36	High systolic blood pressure	6.66	(5.41, 7.90)
(2.43, 3.44)	2.90	Smoking	6.54	(5.48, 7.65)
(1.25, 1.77)	1.49	High fasting plasma glucose	5.48	(4.69, 6.48)
(5.65, 9.34)	7.43	Low birth weight for gestation	4.64	(3.73, 5.71)
(1.04, 4.18)	2.41	Ambient particulate matter pollution	4.31	(2.50, 6.39)
(5.80, 10.34)	8.06	Household air pollution	3.99	(2.67, 5.60)
(0.83, 1.36)	1.07	High LDL cholesterol	3.64	(2.70, 4.57)
(0.10, 0.84)	0.38	High body mass index	3.62	(1.89, 5.66)
(0.46. 0.75)	0.59	Alcohol use	2.84	(2.15, 3.64)
(14.14, 23.43)	18.34	Child wasting	2.23	(1.31, 3.44)

% Attributable DALYs 1990 Risk-related DALYs = 9,074,601.07		Risk factors for DALYs	% Attributable DALYs in 2017 Risk-related DALYs = 4,463,150.16	
(5.97, 13.26)	9.54	Unsafe water source	2.83	(1.60, 4.08)
(5.35, 10.16)	7.47	Unsafe sanitation	1.70	(1.10, 2.33)
(3.17, 8.38)	5.51	No access to handwashing facilities	1.29	(0.72, 2.00)
(4.18, 8.42)	5.98	Vitamin A deficiency	0.69	(0.46, 0.97)
(6.55, 12.72)	9.33	Child underweight	0.68	(0.43, 1.05)
(3.14, 10.74)	6.19	Child stunting	0.34	(0.09, 0.88)
		Broad category		
(47.74, 56.01)	52.14	Behavioral risks	34.15	(31.42, 37.39)
(20.65, 29.05)	24.64	Environmental/occupational risks	17.72	(16.08, 19.48)
(3.81, 5.12)	4.44	Metabolic risks	14.18	(12.25, 16.21)

Annex Table 8: Risk attributable DALYs and their YLLs and YLDs composition, 2017

	Risk-attributable DALYs	YLLs percentage of DALYs	YLDs percentage of DALYs	YLLs-YLDs ratio
Major risk factors				
Child and maternal malnutrition	1,340,325.84	81.87	18.13	4.51
Air pollution	780,332.60	86.10	13.90	6.20
Dietary risks	770,605.18	90.99	9.01	10.10
Tobacco	702,432.11	82.08	17.92	4.58
High systolic blood pressure	599,232.47	93.42	6.58	14.20
High fasting plasma glucose	493,771.50	75.00	25.00	3.00
Occupational risks	418,829.67	45.89	54.11	0.85
High LDL cholesterol	327,876.35	96.17	3.83	25.13
High body mass index	326,257.61	75.56	24.44	3.09
Unsafe WASH	322,425.29	87.07	12.93	6.73
Alcohol use	255,882.72	77.05	22.95	3.36
Impaired kidney function	241,510.61	87.96	12.04	7.31
Other environmental risks	163,907.22	85.17	14.83	5.74
Unsafe sex	128,916.80	92.20	7.80	11.82
Drug use	77,622.55	43.80	56.20	0.78
Low physical activity	59,038.03	91.38	8.62	10.60
Low bone mineral density	35,920.52	73.27	26.73	2.74
Childhood maltreatment	2,9648.45	2.75	97.25	0.03
Intimate partner violence	16,570.19	34.70	65.30	0.53
Broad risk factors				
Metabolic risks	1,276,725.13	84.00	16.00	5.25
Environmental risks	1,595,797.07	75.56	24.44	3.09
Behavioral risks	3,076,269.41	81.38	18.62	4.37
All risk factors	**4463150.16**	**77.93**	**22.07**	**3.53**

Annex Table 9: Major Causes of DALYs and their YLLs and YLDs composition, 2017

	DALYs	YLLs percentage of DALYs	YLDs percentage of DALYs	YLLs-YLDs Ratio
Major causes of disease burden				
Cardiovascular diseases	1,153,568.61	93.04	6.96	13.36
Maternal &neonatal disorders	976,519.57	84.95	15.05	5.64
Chronic respiratory diseases	671,250.36	68.51	31.49	2.18
Respiratory infections &tuberculosis	669,063.19	91.88	8.12	11.31
Musculoskeletal disorders	559,115.20	1.87	98.13	0.02
Neoplasms	503,412.57	98.28	1.72	57.31
Neurological disorders	449,180.10	20.58	79.42	0.26
Enteric infections	404,889.60	88.76	11.24	7.90
Transport injuries	372,304.27	88.79	11.21	7.92
Diabetes &kidney diseases	366,592.67	65.69	34.31	1.91
Unintentional injuries	358,227.09	67.08	32.92	2.04
Other non-communicable diseases	324,701.82	48.96	51.04	0.96
Digestive diseases	323,205.80	88.58	11.42	7.76
Other Infectious diseases	228,266.70	94.29	5.71	16.53
Nutritional deficiencies	212,043.95	18.46	81.54	0.23
HIV/AIDS and STIs	191,044.26	94.55	5.45	17.35
Self-harm &interpersonal violence	167,438.08	86.44	13.56	6.37
Skin diseases	163,097.65	3.81	96.19	0.04
Neglected tropical diseases &malaria	146,183.43	40.47	59.53	0.68
Broad category				
Communicable diseases	2,828,010.71	81.25	18.75	4.33
Non-communicable diseases	5,289,340.21	53.63	46.37	1.16
Injuries	897,969.44	79.69	20.31	3.92
All-cause	**9,015,320.36**	**64.89**	**35.11**	**1.85**

Nepal Health Research Council (NHRC)

Ramshah Path, Kathmandu, Nepal

Tel: +977-1-4254220

Fax : 977-1-4262469 / 977-1-4268284

Email : nhrc@nhrc.gov.np

Website: www.nhrc.gov.np