PERSPECTIVE

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# Addressing the global Challenge of NCDs using a Risk Factor approach: voices from around the world

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## Abstract

Noncommunicable diseases (NCDs) are growing at an alarming rate around the world, drawing attention in multiple United Nations high-level meetings, the Sustainable Development Goals, regional alliances for NCDs, and in scientific research agendas. In 2018, the World NCD Federation selected the University of Michigan from seven universities around the world to host the 2nd World NCD Congress in 2020. For the scientific program, we defined an intersecting matrix of "risk factors" and "disease-oriented" lenses for examining NCDs to highlight the multiple risk factors that contribute to major NCDs. Through deliberation with two committees representing over 50 individuals and 11 countries, eight risk factors were selected for the scientific program: social determinants of health and demographics, climate and environment, stress, sleep, substance use, nutrition, and physical activity, and genetics. These eight risk factors served as submission categories for a call for abstracts as well as topics for the planned plenary sessions. In April 2020, we pivoted our approach when meeting in person for a conference was no longer feasible. Building upon the risk factor model, we shifted the invited talks to invited articles for publication as a special collection for FASEB BioAdvances. We are delighted to launch this collection with 13 invited articles by 32 experts from ten countries. Significant transferable lessons about key risk factors and prevention of NCDs from this collection could be leveraged in various geographic areas and in settings with varying levels of resources, as they cover a diverse range of topics from community-level interventions to indigenous leadership structures to national policies to intergovernmental programs.

**KEYWORDS**

cardiovascular diseases, chronic diseases, environment and public health, noncommunicable diseases, nutritional and metabolic diseases, sustainable development goals

## 1 | INTRODUCTION

In the midst of a global pandemic for a virus that has up-ended our collective reality, focusing on noncommunicable diseases (NCDs) may seem counterintuitive. However, NCDs remain the top causes of deaths worldwide.[1] Additionally, there are well-documented interdependencies between chronic diseases and COVID-19 – greater

vulnerability for COVID-19 among those with NCDs, higher frequency of complications of the chronic illness in the setting of the infection, and longer term complications resulting from COVID-19 itself.[2]

Major NCDs – obesity, diabetes, cardiovascular diseases (CVD), and cancer – have been prioritized by world bodies over the past decade, with three high-level United Nations (UN) meetings on NCDs, integration of NCD targets into the Sustainable Development Goals (SDGs), and emergence of new grassroots regional alliances for NCDs.[3,4] The rising burden of NCDs worldwide represents an epidemic that affects individuals regardless of age, income, or geography. Currently, the focus is almost entirely on downstream crisis management of chronic diseases and their complications. This reactive approach is simultaneously inefficient, ineffective and risky (both in terms of duration and quality of life), and very, very costly.

In pursuit of shifting the paradigm to *prevention of NCDs*, the University of Michigan (U-M) partnered with the World NCD Federation (WNF) to host the 2nd World NCD Congress on its campus in Ann Arbor, Michigan, USA. Selecting the theme for 2020 of "Preventing NCDs at All Levels: Knowledge to Action," the Congress aimed to examine the four levels of prevention - primordial, primary, secondary, and tertiary – across an intersecting matrix of eight risk factors associated with multiple NCDs: social determinants of health and demographics, climate and environment, stress, sleep, substance use, nutrition, physical activity, and genetics. The scientific program was designed not only to highlight lessons from a broad spectrum of scientific disciplines, but also the coming together under one roof, of a diverse group of researchers and practitioners, representing many countries, geographic areas, and multiple sectors.

In this editorial, we describe how and why we selected this risk factor-based approach as a unifying, guiding framework for NCD prevention, in consultation with our conference's scientific committees. When COVID-19 disrupted the plans for our in-person conference in August 2020, we were able to pivot and repurpose the risk factor approach from the conference format of parallel sessions and plenaries into a publication-based strategy of abstract proceedings with the Federation and of invited articles in a special collection with FASEB BioAdvances. We introduce the resulting special collection launched with 13 invited articles by 32 experts from ten countries.

## 2 | SCIENTIFIC PROGRAM FOR THE 2nd WORLD NCD CONGRESS

In 2018, U-M applied and was selected by the WNF from seven universities around the globe who applied to host the 2nd World NCD Congress in 2020. The WNF is a professional association established in 2015, in India. In 2017, WNF launched the World NCD Congress Series, with the 1st hosted by the Postgraduate Institute of Medical Education and Research (PGIMER) in Chandigarh, India. The theme of the 2017 Congress was "Preventing Noncommunicable Diseases: Realizing Sustainable Development Goals." WNF has selected the University of Toronto to host the 3rd World NCD Congress in 2023.

As part of planning for the 2nd World NCD Congress, we established two committees representing over 50 individuals and 11 countries to advise the scientific program of the Congress, including its structure, topics, speakers, authors, reviewers, and audience. In order to coordinate stakeholders across our large university, we created the Internal Steering Committee, which consists of 30+ faculty and senior staff across seven schools/colleges within U-M, with experts in medicine, epidemiology, kinesiology, behavioral sciences, nursing, information sciences, learning health systems, policy, and other disciplines. We created a second committee with external counterparts, called the Global Advisory Committee, which consists of 20+ members representing 11 countries, with experts in nutrition, community health, health program design for indigenous populations, public health, cardiology, and other topics.

## 3 | THE "LEVELS" AND RISK FACTORS

In collaboration with our two committees, we selected the 2020 theme of "Preventing NCDs at All Levels: Knowledge to Action." By "all levels," we had in mind a double meaning: the norm of four levels of prevention of public health – primordial, primary, secondary, and tertiary (see Table 1) – as well as regional levels of local, national and international interventions. Chronic disease *management* at individual/patient-level is crucial, but in order to reduce incidence on a population scale, one must look to prevention. The cost of NCDs to the healthcare system is in the trillions of dollars, largely because the current priority is secondary and tertiary, rather than primary prevention. Due to misaligned financial incentives, upstream primary prevention remains neglected.

In order to prevent NCDs upstream, it is necessary to identify, control or eliminate their "root causes." At times, identifying cause and effect from "risk factor" to disease onset is straightforward; in other cases, multiple risk factors interact with the body's biological processes in a more complex fashion. Through deliberation with our two committees, we concluded that emphasizing the risk factor approach would provide a unifying, clear lens for prevention that would transcend traditional siloes of disease management and cut across the normal boundaries of the basic sciences, clinical

**TABLE 1** Levels of prevention

| Level | Definition |
|---|---|
| Primordial | Primordial prevention focuses on broad, population-level interventions to prevent or lower disease risk factors for NCDs.[5] |
| Primary | Primary prevention intervenes at the individual level before the occurrence of negative health effects; examples include vaccination and changing behaviors that increase risk of NCDs.[6] |
| Secondary | Secondary prevention aims to identify disease in its earlier stages, using screening measures like blood pressure checks and pap smears,[6] and includes prompt attention to abnormalities discovered to prevent disease progression. |
| Tertiary | Tertiary prevention focuses on management of advanced disease and its complications, reduction of disability through rehabilitation.[6] |

**TABLE 2** Selected risk factors for NCDs for the scientific agenda

| Risk factor | Correlation with NCDs |
|---|---|
| Social determinants of health | Social determinants of health – the conditions in which an individual is born, grows, lives, works and plays, include domains such as income, housing, food and water availability and therefore, nutrition, racial segregation and racism, quality of public and private transportation, education, broadband connectivity, health systems and access to care.[7] Social determinants of health have a huge impact on population health, and help explain disparities in access to health care, preventive services and health outcomes.[8-10] |
| Climate and environment | Climate change and environmental factors such as shifts in global weather patterns and the combination of urban density and heavy pollution, which can lead to respiratory diseases and other NCDs.[11] |
| Stress | Physical or emotional stress or trauma affects human behavior, and can underlie stress-related metabolic alterations leading to mental health problems, such as depression and anxiety, on the one hand, and also disorders such as metabolic syndrome (hypertension, obesity, and insulin resistance), thereby contributing to or worsening NCDs.[12] |
| Sleep | Impairment of sleep quality affects mental, physical, and cognitive health. It can also weaken the immune system and increases risk of diabetes, CVD, and inflammation-related conditions.[13] |
| Substance use | Substance abuse and addiction are closely linked with mental health disorders. These in turn also increase risk of multiple NCDs. Tobacco and alcohol increase risk for cancer, heart disease, and respiratory conditions, among others.[14] |
| Nutrition | Malnutrition and over nutrition are both NCD risk factors, with over nutrition as a rising concern. Over nutrition can lead to heart disease, diabetes, stroke, and cancer, and is a leading cause of obesity.[15] |
| Physical Activity | Sedentary behavior and low levels of exercise put individuals at higher risk for obesity, diabetes, CVD, and dementia.[16] |
| Genetics | Genetics can predispose an individual to NCDs like cancer, CVD, diabetes, kidney disease, asthma, and mental health disorders.[17] Gene environment relationships and epigenetics remains an area fertile for research in the field of NCDs. |

sciences, public health and other sectors. We identified eight risk factors common to multiple NCDs: social determinants of health and demographics, climate and environment, stress, sleep, substance use, nutrition, physical activity and genetics (Table 2). These eight risk factors served as submission categories for a call for abstracts as well as topics for the planned plenary sessions.

The presence of one NCD is often a risk factor for others, or owing to common risk factors, co-existence of multiple comorbidities is common. In the United States, treatment for adults of all ages with multiple chronic conditions accounts for over two-thirds of all healthcare spending. Almost three in four individuals aged 65+ have multiple chronic conditions.[18] Over 90% of Medicare costs are for chronic diseases and 45% of Medicare costs are for the 17% of Medicare patients with six or more chronic diseases.[18] Investing in prevention of chronic diseases can significantly decrease government healthcare costs overall.

# 4 | SHIFTING TO A PUBLICATION APPROACH

The 2nd World NCD Congress included a call for abstracts from December 2019 to March 2020, inviting submissions related to the risk factors and to levels of prevention and disease management. A total of 225 abstracts were received. Through a peer review process with 37 scientific experts and practitioners from 16 countries around the world, 195 abstracts were accepted. All risk factors and levels of

prevention were represented. The geographic diversity of accepted submissions was impressive, with representation from 36 countries and six continents. In terms of sectoral diversity, abstracts came overwhelmingly from academia, followed by modest representation of government and NGO sectors, with few private and philanthropic contributors. Risk factors such as genetics, sleep, climate and environment, as well as tertiary prevention, were relatively underrepresented. Certain geographic regions were underrepresented, most notably South America and Oceania.

Due to the COVID-19 pandemic, we decided to postpone the conference, originally planned for August 2020. In April 2020, we pivoted our approach when meeting in person for a conference was no longer feasible. The accepted abstracts from 2020 are scheduled to be published as proceedings in partnership with the WNF in 2021. Planning discussions are underway for an alternative virtual conference.

Building upon the risk factor model, we shifted the invited talks to invited articles for a special collection in a series for a journal. The publication strategy resonated as an effective way to expand the reach of the conference message to a wider audience, as well as providing the opportunity to discuss each risk factor in-depth. With a publication series, we intended to maintain the principles and scientific core from the conference. We would keep the goals of the NCD prevention and management, the cross-cutting, risk factor approach, and the diversity commitments to geography, ethnicity, gender parity, multiple sectors, and multiple scientific disciplines.

In search of a publication partner, we were delighted to find a match with FASEB BioAdvances for this special collection. The conference aims and scope align well with those of FASEB BioAdvances, emphasizing multidisciplinary research from a global community of scientists and other stakeholders.

**TABLE 3** Diversity statistics of special collection authors

| Indicators | Number | Percent |
| --- | --- | --- |
| Gender parity | | |
| Female | 18 | 56.2% |
| Male | 14 | 43.8% |
| Geographic diversity | | |
| Asia | 12 | 37.5% |
| North America | 11 | 34.3% |
| Africa | 7 | 21.9% |
| Central America | 2 | 6.3% |
| South America | 0 | 0% |
| Europe | 0 | 0% |
| Oceania | 0 | 0% |
| Middle East | 0 | 0% |
| Ethnic diversity | | |
| Asian | 14 | 43.7% |
| Black | 11 | 34.4% |
| White | 6 | 18.7% |
| Indigenous | 1 | 3.2% |
| Hispanic | 0 | 0% |
| Arab | 0 | 0% |
| Pacific Islander | 0 | 0% |
| Sector | | |
| Academia | 22 | 68.7% |
| Government | 6 | 18.7% |
| Nonprofit / Nongovernmental Organizations | 3 | 9.4% |
| Professional Societies | 1 | 3.2% |
| Private Industry | 0 | 0% |
| Philanthropy | 0 | 0% |

# 5 | SELECTION OF ARTICLES FOR THE COLLECTION

This selection of 13 invited articles addresses aforementioned risk factors as well as several cross-cutting topics, written by an impressive roster of global experts (see Table 3). The 32 authors represent four continents and ten countries: Jamaica, Nepal, Ghana, Nicaragua, India, Malaysia, Ethiopia, Canada, Kenya, and the United States. Women comprise 56.3%, or 18 of the 32, authors. The authors come from academia, government, nonprofit, nongovernmental organizations, and professional societies. The authors represent diverse disciplines: physical education, learning health systems, epidemiology, environmental health sciences, information sciences, public policy, and medicine and subspecialties in cardiology, nephrology, pulmonology, emergency medicine, psychiatry, and traditional medicine.

While we are proud of the diversity attained in the collection to date, there are some areas where we fell short of our diversity and inclusion targets. Most notably, we were only able to address seven out of the eight risk factors. Despite reaching out to several experts in the field of genetics, we were unable to secure one for this collection. We also acknowledge that there is a gap in the current selection related to specific cancers within the overall NCD landscape. Furthermore, we do not yet have geographic representation from Europe, the Middle East, or Oceania, nor from Hispanic, Arab, or Pacific Islanders ethnic groups. Lastly, we do not have representation from the private nor philanthropic sectors nor from nursing, social work, dentistry or oral health disciplines.

## 5.1 | Social determinants of health

This special collection examines social determinants of health in two articles. One article examines social determinants of cardiovascular health, with a focus on vulnerable

populations and the Jamaica experience, by Dr. Ernest Madu, Dr. Kenechukwu Mezue, and Kristofer Madu, and also discusses strategies for eliminating health disparities in these vulnerable populations. Another article about global disparities and NCDs by Dr. Christine Ngaruiya, provides a broad overview of health disparities in NCDs, looking at health inequities in vulnerable populations around the world and providing actionable solutions.

## 5.2 | Climate and environment

Nearly 14% of all NCDs can be attributed to environmental factors, particularly air pollution, including 29% of chronic obstructive pulmonary disease (COPD)-related deaths.[19] In the coming decades, climate change will accelerate and potentially lead to forced displacement and food insecurity, as well as disrupted childhood development due to exposure to pollution and chemicals.[20] Additionally, the impact of climate change is unevenly distributed, with those in low- and middle-income countries bearing the brunt.[21] The special collection will include an article that looks to understand the linkage between environmental risk factors and NCDs, by Drs. Meghnath Dhimal, Tamanna Neupane, and Mandira Lamichhane Dhimal. The article will look at eight different study designs which can be used to identify and measure causal and correlational relationships between the environment and NCDs, concluding with a discussion of projections for the impact of climate on health in the future.

## 5.3 | Stress

Stress is an increasing concern in the context of NCDs and can lead to pulmonary disease, gastrointestinal disease, cancer, diabetes, and arthritis, as well as a host of neuropsychiatric disorders. Additionally, stress-related metabolic syndrome (high cholesterol, hypertension, among others) is a risk factor for multiple NCDs.[9] The special collection will showcase stress as a risk factor for diabetes, with an article that delves into the complex interplay between psychological stress and sleep deprivation, which contribute to the pathophysiology of type 2 diabetes mellitus. The article, by Drs. Alexander Lourdes and Wah-Yun Low, review population-level interventions implemented in Malaysia to address this problem.

## 5.4 | Sleep

Insufficient quality sleep can negatively impact mental health, as well as cognitive and physical functioning. Further, sleep deprivation can negatively impact mental health and the immune system, and can also increase risk of diabetes,

CVD, and inflammation-related ailments.[10] One of the most common sleep disorder types is sleep apnea,[22] which will be discussed further in this collection's article on "the overlap syndrome" of obstructive sleep apnea and COPD, by Dr. Tejas Menon Suri and JC Suri. The article will look at the approach to diagnosis and treatment of sleep disordered breathing in patients with COPD, and associated therapies like positive airway pressure therapy.

## 5.5 | Substance use

Two of the four leading behavioral risk factors for NCDs are tobacco and alcohol use. Globally, tobacco is responsible for 7 million deaths annually, while alcohol is responsible for 3.3 million deaths.[11] Substance abuse includes both tobacco and alcohol as well as opioids and hallucinogens, among other frequently abused substances. This special collection will highlight the burden of substance abuse from several angles. One, by H.E. Dr. Lia Tadesse, Dr. Tedla Giorgis, and Heran Gerba, will look at the policies, delivery methods, and lessons learned from integrating substance abuse services into primary care in Ethiopia. The other, by Drs. Amy Kilbourne, Emily Evans, and David Atkins, will look at how the development of a learning health system within the US Veterans Affairs assists in implementing effective treatment and further research for opioid use.

## 5.6 | Nutrition

While under- and malnutrition remain significant contributors to NCDs in low-and middle-income countries, overeating or other unhealthy diets are leading to rising obesity around the globe. Diet is one of the four leading behavioral risk factors for NCDs, and is associated with CVD, diabetes, hypertension, cancer, and stroke.[12,23,24] This special collection will highlight the importance of food security with an article by Dr. Myrna Cunningham Kain, detailing the role of indigenous women in eight countries in Latin America, utilizing traditional and holistic approaches to ensure food security and community wellbeing amid the COVID-19 pandemic.

## 5.7 | Physical activity

Globally, one in four adults are not sufficiently physically active.[25] The problem is more significant in high-income countries, though insufficient inactivity is also a problem in low- and middle-income countries.[26] Inadequate levels of physical activity is a primary risk factor for CVD, diabetes, and obesity. Two articles in this special collection will expand on physical activity as a risk factor for NCDs from

different perspectives. One, by Vida Korleki, Doris Tay, Esther Adu, and Dr. Reginald Ocansey, will look at the physical activity policies in Ghana, providing a review of physical activity monitoring for NCDs countrywide. The other, by Dr. Arun Chockalingam, Emily Ginier, and Dr. Rajiv Saran will look at the impact of COVID-19 lockdowns on physical activity and stress, in relation to prevention and management of NCDs. Specifically, the article will focus on CVD and hypertension.

## 5.8 | Cross-cutting

In the United States, deaths from communicable diseases, including all excess deaths possibly attributable to COVID-19, are still much lower than deaths attributable to heart disease, let alone other NCDs.[27] Furthermore, the interplay between communicable and noncommunicable diseases is complex, and particularly with regards to COVID-19, is not fully understood. The intricacies of communicable and noncommunicable disease interaction will be discussed further in an article that will detail the impact of COVID-19 on the kidneys. The article, by Drs. Smita Divyaveer and Vivek Jha in India, will look into chronic kidney disease as an outcome of COVID-19, and will also discuss the impact of the pandemic on those already living with kidney disease, particularly those on dialysis or on a transplant waitlist.

The final article showcased in this special collection takes a retrospective look at the global drive to achieve the SDGs related to NCDs. The article, by Dr. JS Thakur, Ria Nangia, and Dr. Sukriti Singh, examines the NCD targets for 2030 within the SDGs, the progress made five years into implementation, and analyzes the challenges and lessons learned resulting from the implementation process.

## 6 | CLOSING REMARKS

We hope that readers of this special collection gain insight into the risk-factor approach to NCD prevention. These articles build upon some of the well-documented NCD risk factors, as well as some lesser researched risk factors. Covering a diverse range from community-level interventions to indigenous leadership structures to national policies to intergovernmental programs, there are significant transferable lessons to be learned about the risk factors and prevention of NCDs in various geographic areas and in settings with varying levels of resources. This special collection aims to stimulate broad discussion of NCD prevention through enriched understanding of NCD risk factors, leading to targeted upstream interventions that reduce the global burden of disease and enhance quality of life.

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