



P-ISSN: 2349-8528

E-ISSN: 2321-4902

www.chemijournal.com

IJCS 2023; 11(5): 43-49

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Received: 21-05-2023

Accepted: 30-06-2023

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A comprehensive review of non-communicable diseases: Trends, risk factors, and preventive interventions

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Abstract

Non-communicable diseases (NCDs) constitute a significant global health challenge, encompassing conditions like cardiovascular diseases, cancer, diabetes, and chronic respiratory ailments that contribute substantially to global mortality and morbidity. The increasing prevalence of NCDs emphasizes the urgency of preventive measures and interventions. This review examines the multifaceted aspects of NCDs, including their underlying mechanisms such as chronic inflammation, oxidative stress, metabolic dysfunction, and epigenetic modifications. Strategies targeting modifiable risk factors through public health policies, promotion of healthy lifestyles, early detection, and medical interventions are pivotal in the battle against NCDs. Furthermore, recognizing the life course approach and integrating NCD prevention into maternal and women-centric health programs holds significance. Global efforts, as exemplified by initiatives like the UN High-Level Meeting and the '25 by 25' goal, underscore the collective commitment towards NCD prevention. The proposed priority targets and stepwise approach by The Lancet NCD Action Group offer practical guidelines for effective prevention strategies. With NCDs affecting nations universally, a comprehensive understanding of risk factors, mechanisms, and interventions is vital to mitigate their impact. By collectively addressing common risk factors and embracing healthier lifestyles, people can work towards reducing NCD prevalence and enhancing global well-being.

Keywords: Non-communicable diseases, NCDs, cardiovascular diseases, cancer, diabetes, chronic respiratory diseases, risk factors, interventions, prevention

Introduction

Non-communicable diseases (NCDs) have emerged as a significant focal point in the 21st century. NCDs are a leading global public health problem, as established by the United Nation Summit on NCDs in September 2011 (Samuels *et al.*, 2014) [49]. The contemporary way of life has rendered individuals susceptible to a variety of chronic NCDs. Non-communicable diseases (NCDs), also known as chronic diseases, encompass a diverse group of health conditions that are not caused by infectious agents. Non-communicable diseases (NCDs) encompass a wide range of health conditions, including cardiovascular diseases, cancer, diabetes, and chronic respiratory illnesses. These ailments contribute to a significant number of deaths on a global scale, amounting to around 38 million fatalities, which constitutes about 68% of all deaths. In India, NCDs are accountable for approximately 5.87 million deaths, making up 60% of the total number of deaths. The leading causes of NCD-related mortality and health challenges are four specific diseases: cardiovascular diseases, chronic respiratory illnesses, cancers, and diabetes. NCDs are the primary drivers of worldwide mortality, constituting more than 74% of the overall disease burden across the globe. Between 2000 and 2019, NCDs resulted in the premature death of around 277 million individuals aged 30 to 70 in low- and middle-income countries (WHO, 2019) [45]. NCDs have multifactorial origins, often involving complex interactions between genetics, lifestyle choices, and environmental factors (WHO, 2021). The continuous increase in non-communicable diseases (NCDs) on a global scale poses a significant key challenge on the global health agenda. These persistent health issues are not only the primary driver of worldwide mortality but also present a growing challenge in terms of both sickness and death rates, particularly in developing nations.

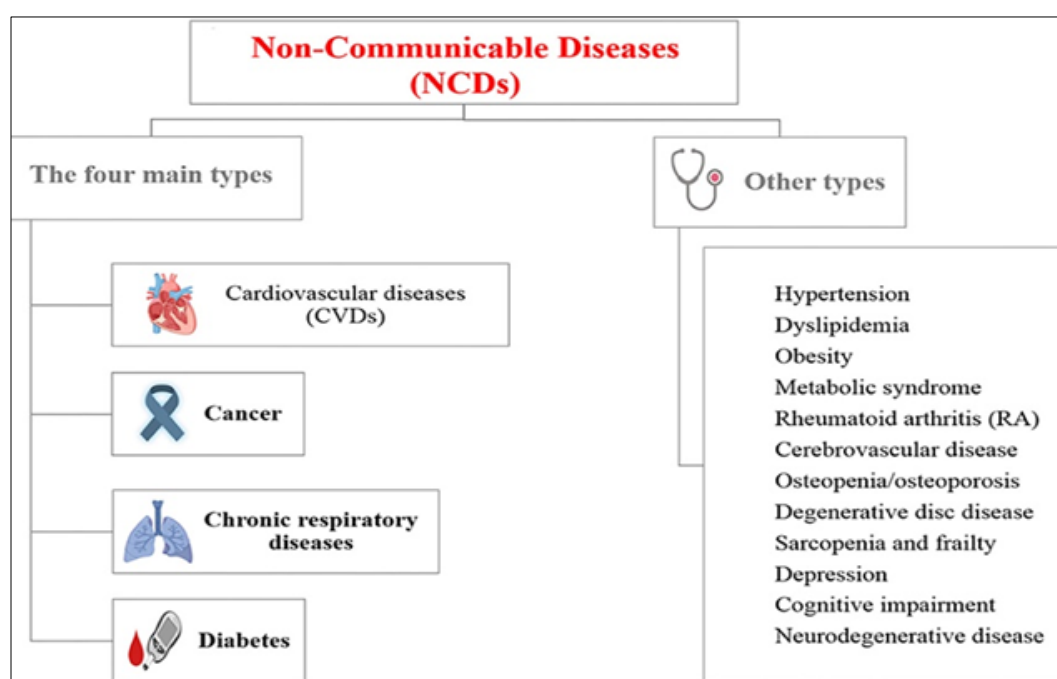
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Major Categories of NCDs

The major categories of non-communicable diseases (NCDs) encompass a range of conditions. Cardiovascular diseases encompass conditions such as atherosclerosis, hypertension, and heart failure. The category of cancer includes various types like lung, breast, colorectal, and prostate cancers. Diabetes covers both type 1 and type 2 diabetes mellitus. Chronic respiratory diseases consist of chronic obstructive pulmonary disease (COPD) and asthma. A significant milestone was reached in 2016 when dementia was added to the World Health Organization's (WHO) list of the top 10 global causes of death within the realm of NCDs. This change placed dementia alongside other influential contributors, including coronary heart disease (CHD), stroke, diabetes mellitus (DM), and several types of cancer (WHO, 2019) [54]. Analysing different economies revealed the consistent prominence of CHD and stroke as leading causes of death and contributors to NCD-related mortality. DM's prevalence was observed across various income categories except the lowest,

while dementia emerged as a top five cause of death in upper-middle- and high-income nations (WHO, 2019) [55]. In the domain of cancers, such as trachea, bronchus, lung, liver, stomach, colon, rectum, and breast cancers, these diseases held positions among the top 10 causes of death in upper-middle- and high-income countries during 2016. It is crucial to emphasize that dementia, like other NCDs such as CHD, not only shares its ranking within the list but also common lifestyle and clinical risk factors [Meschia *et al.*, (2014), Bayo *et al.*, (2019), Arnett *et al.*, (2019) [56-58]]. These factors, including obesity, physical inactivity, high blood pressure, depression, high cholesterol, unhealthy diet, smoking, excess alcohol consumption, and even air pollution, have been identified by the WHO as prevalent and modifiable contributors underlying the majority of non-communicable diseases (WHO, 2019) [59]. This highlights the interconnected nature of these diseases and the potential for focused interventions to address shared risk factors, ultimately contributing to the reduction of the global burden of NCDs.



Source: Budreviciute *et al.*, (2020) [18]

Fig 1: List of non-communicable diseases (NCDs)

Prevalence and Global Burden of NCDs

Most non-communicable disease (NCD) fatalities are concentrated in low and middle-income nations like India. In these countries, there's a significant shift in health trends due to swift urbanization, driving overall economic growth alongside certain downsides in the form of risk factors. Research indicates that non-communicable diseases (NCDs) present differently in affluent and underprivileged populations and significantly forecast premature death and variations in older individuals' life spans. The Global Burden of Diseases (GBD) report identifies cardiovascular diseases, chronic lung ailments, and diabetes as prominent global causes of death. In India, NCDs are responsible for nearly 6 million fatalities. The GBD India collaborators noted that cardiovascular diseases are the primary contributors (34.3%) to India's mortality load, while diabetes accounts for 2.5% of total mortality burden. Furthermore, the prevalence of NCDs is on the rise in India, especially among older adults, carrying significant public health implications. The wealthy have a higher prevalence of HTN and DM than the poor section, as

well as significant disparities in preventive care among people with HTN or DM (Khura *et al.*, 2022) [17].

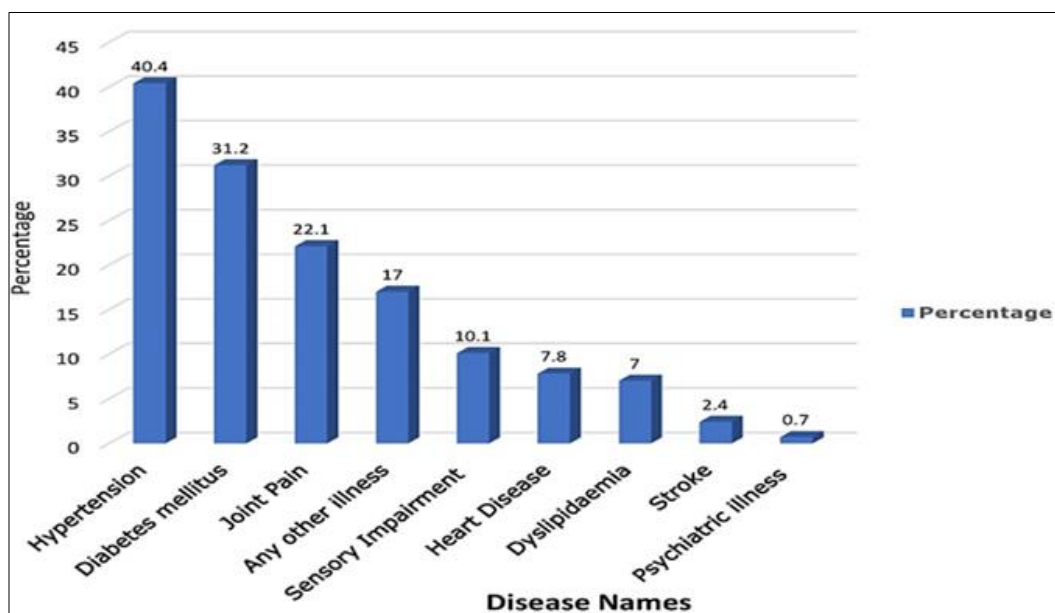
Agarwal *et al.*, (2018) [19] revealed varied prevalence rates of different risk factors. Tobacco smoking and smokeless tobacco use were noted in 26.2% and 27.08% of individuals respectively. Alcohol consumption was prevalent in 24.1%, while insufficient fruit/vegetable intake was high at 91.61%. Over 5 grams of salt intake per day was seen in 10.9% participants, and overweight/obesity affected 34.86%.

Certain demographics showed significant trends: individuals over 35, males, illiterates, and those from scheduled castes/tribes had a higher inclination towards tobacco and alcohol use. Alcohol consumption was notably higher among employed upper and upper-middle class individuals, while tobacco use was more common in lower socioeconomic groups. Excessive salt consumption was prominent among those aged 35-65, females, literate individuals, those from other backward castes, and government employees.

Asogwa *et al.*, (2021) concluded that a high burden of multimorbidity in LMICs, especially among women, the

people who are well-off, and people residing in urban areas, with cardiometabolic and cardiorespiratory profiles being the

most prevalent patterns of multimorbidity.



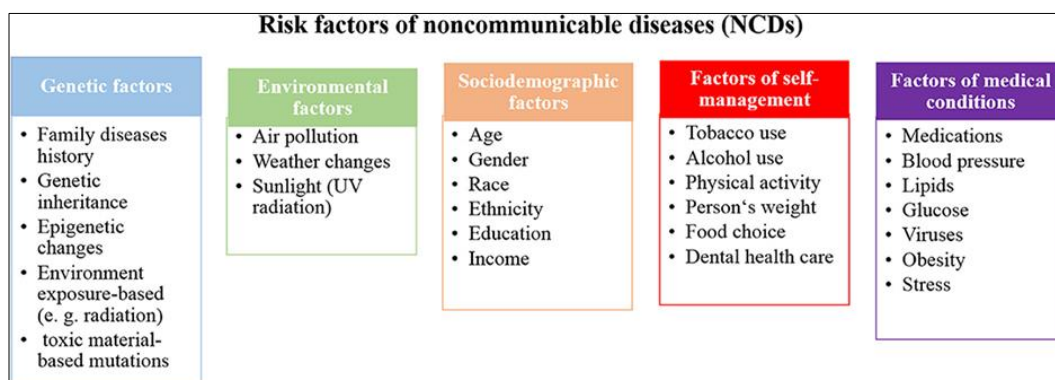
Source: Chobe *et al.*, (2022) [18]

Fig 2: Graph showing non-communicable disease prevalence among the elderly

Risk Factors for NCDs

A risk factor refers to personal behaviours, lifestyles, environmental exposures, or hereditary traits that increase the likelihood of specific diseases, injuries, or health conditions (Centres for Disease Control and Prevention, 2006) [7]. The majority of non-communicable diseases (NCDs) originate from modifiable risk factors, divided into behavioural and biological categories, which significantly contribute to susceptibility (Rodgers and Vaughan, 2002) [4]. These factors encompass behaviours like tobacco and alcohol usage, sedentary routines, obesity, excessive consumption of fat and sodium, inadequate intake of fruits and vegetables, and elevated levels of blood pressure, blood glucose, and cholesterol (WHO, 2013) [8]. Timely intervention to address these factors can effectively avert the emergence of future NCDs. This underscores the importance of broad-based population-level monitoring, achieved through the standardized "WHO STEP-wise approach to NCD risk factor surveillance (STEPS)" (WHO, 2005) [6]. Several key factors play a role in the susceptibility to NCDs: Lifestyle factors, including an unhealthy diet, physical inactivity, tobacco use, and excessive alcohol consumption, contribute significantly to

risk. Genetic predisposition comes into play through the interaction between an individual's genetic susceptibility and various environmental triggers (WHO, 2013) [8]. Environmental influences, such as exposure to air pollution, toxins, and the impacts of urbanization, further exacerbate vulnerability. Socio-economic determinants, including income, education, and access to healthcare services, also shape the risk landscape for NCDs. Collectively, these factors shape the complex interplay leading to non-communicable diseases, emphasizing the need for comprehensive strategies that address these factors across diverse populations. According to a survey, the risk factors associated with heart disease and stroke, the top causes of death for women and men alike, exhibit similarities between genders (Lim *et al.*, 2013) [29]. Dietary factors have comparable impacts on the health of both women and men. Except for high body mass index and elevated fasting plasma glucose levels, most primary risk factors for non-communicable diseases (NCDs) have experienced a decline, particularly in high-income nations (Bustreo *et al.*, 2012) [28]. The prevalence of obesity raises concern for women, as they tend to have higher obesity rates than men across most regions.

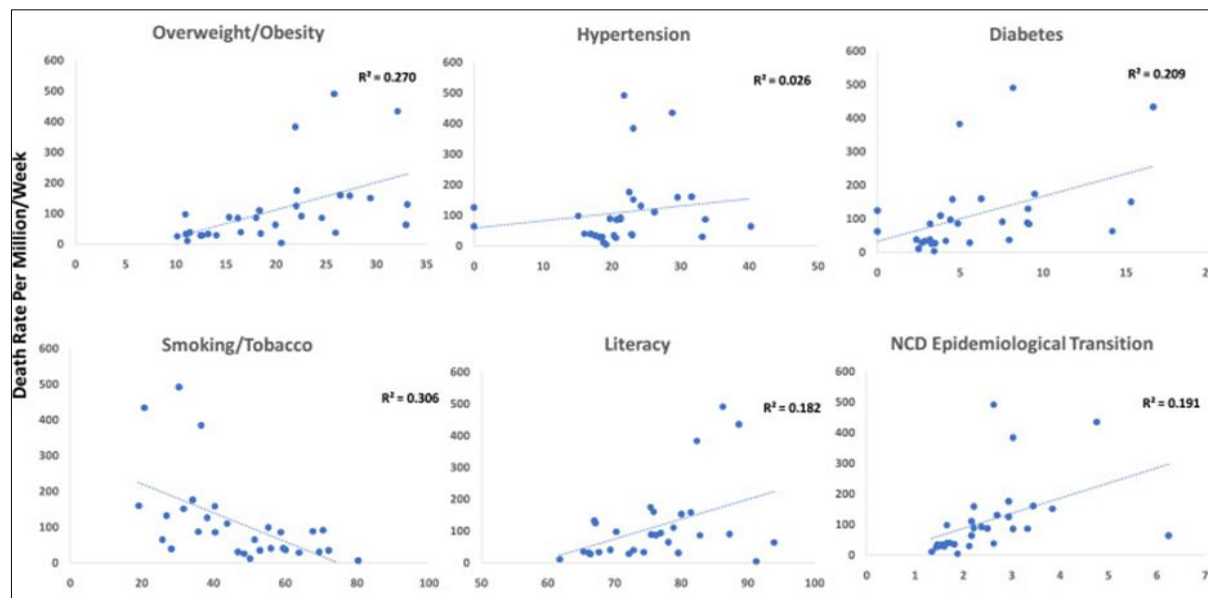


Source: Budreviciute *et al.*, (2020) [48]

Fig 3: A proposed model to classify the risk factors of NCDs.

There is strong association of COVID-19 with non-communicable diseases (NCDs) and their risk factors (Lancet, 2020) [32]. Multiple studies from across the globe have reported that individuals with established coronary heart disease, heart failure, chronic respiratory, renal or liver disease and cancers or their risk factors such as diabetes, hypertension, obesity, and other vascular risk factors are at greater risk of acquiring infection and developing complications and deaths from COVID-19 [Guan *et al.*, (2020), Richardson *et al.*, (2020), Cummings *et al.*,

(2020), Williamson *et al.*, (2020), Yadav *et al.*, (2020), Gutierrez *et al.*, (2020), Chang *et al.*, (2020), Hernández *et al.*, (2020), Bergman *et al.*, (2020) [33-41]. Environmental factors such as urbanization, crowding, ambient and indoor air pollution, poor sanitation and low socioeconomic status are also important in increasing the risk of disease incidence and deaths [Williamson *et al.*, (2020), Meyerowitz *et al.*, (2020), Holuka *et al.*, (2020), Copat *et al.*, (2020)] [36, 42-44].



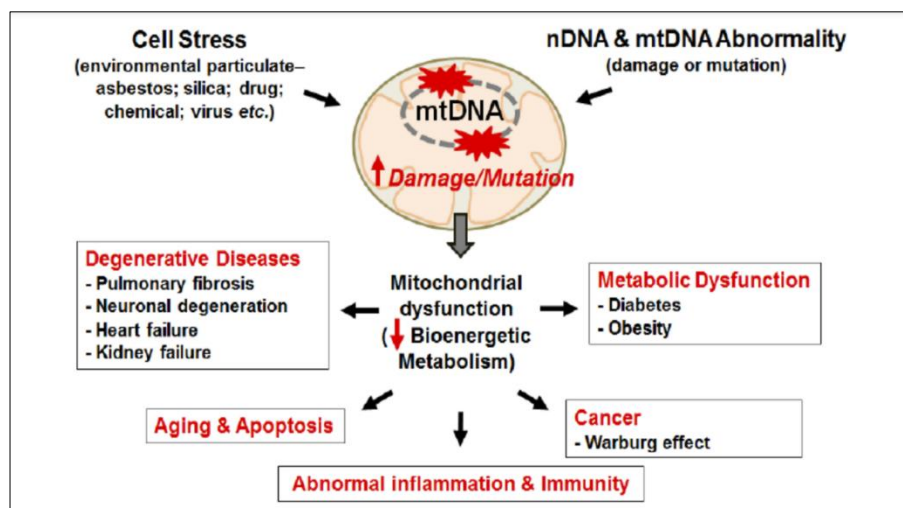
Source: Gaur *et al.*, (2021)

Fig 4: Association of non-communicable disease (NCD) risk factors with cumulative COVID-19 deaths/million.

Underlying Mechanisms of NCDs

Chronic inflammation, oxidative stress, and metabolic dysfunction are key contributors to non-communicable diseases (NCDs) like cardiovascular diseases, diabetes, and cancers. Mitochondria are pivotal in regulating energy metabolism and cellular equilibrium through functions such as bioenergetics, ROS production, apoptosis, and signal transduction. These dynamic organelles respond to various signals, affecting processes like mitochondrial DNA stability, respiration, and stress response. However, disrupted fusion and fission processes can lead to compromised bioenergetics

and ROS-generating damaged mitochondria. Dysfunctional mitochondria, generating ROS, further harm other mitochondria, contributing to age-related disorders. Global non-communicable diseases linked to unhealthy lifestyles share mechanisms involving mitochondrial abnormalities, inflammation, and oxidative stress. This stress affects Endoplasmic Reticulum and mitochondria, promoting obesity and metabolic syndrome. Prioritizing mitochondrial health could counteract age-related ailments and non-communicable diseases (Geto *et al.*, 2020) [60].



Source: Geto *et al.*, (2020) [60]

Fig 5: Mitochondrial damage induces diverse chronic and degenerative diseases

Additionally, epigenetic modifications alter gene expression without changing DNA sequence. Influenced by environment, lifestyle, and aging, they impact crucial pathways related to NCDs, potentially increasing vulnerability to conditions like cancer. Experiences during our early years can change how our genes work through epigenetic changes, making us more prone to diseases. Recent scientific discoveries support what studies have shown before - that the time when we are young is crucial in determining our chances of developing chronic health problems like obesity, type 2 diabetes, and heart conditions (Gluckman *et al.*, 2009) ^[61]. Recognizing and understanding these intricate mechanisms are crucial for effective strategies in preventing and managing NCDs. By addressing chronic inflammation, oxidative stress, and metabolic dysfunction, as well as considering the impact of epigenetic modifications, it becomes possible to develop targeted interventions that mitigate the risk and progression of these diseases, ultimately promoting better health outcomes.

Preventing and Addressing NCDs: A Multi-Faceted Approach

This involving various strategies

- 1. Public Health Policies and Initiatives:** This involves using different strategies to prevent and manage non-communicable diseases (NCDs), like heart disease and diabetes. These strategies include taking comprehensive measures to reduce tobacco use, putting taxes on unhealthy products such as sugary drinks and foods high in salt, running campaigns to educate people about the factors that increase the risk of NCDs and the importance of healthy behaviours.
- 2. Surveillance and Data Collection:** This means collecting information about the things that increase the risk of NCDs and keeping track of them. It's important to address the lack of enough data about risk factors and to make sure the methods used for collecting data are the same across the board.
- 3. Promoting Healthy Lifestyles:** Encouraging people to live in ways that are good for their health by encouraging regular physical activity, like exercise. Improve lifestyle activities include healthy diets and focus on limiting the use of salt, sugar, and saturated fats (Springmann *et al.*, 2018) ^[63]. Teaching techniques to manage stress and mental well-being.
- 4. Early Detection:** Finding out about potential health problems before they become serious, regular check-ups and tests that can identify risk factors or early signs of diseases, early action can help prevent conditions from getting worse.
- 5. Pharmacological and Medical Interventions:** Using medicines and medical procedures to treat NCDs, When lifestyle changes alone aren't enough, medications can be used for conditions like high blood pressure, high cholesterol, or diabetes. Sometimes, surgeries or other medical treatments are needed for specific conditions.
- 6. National Programme for Health Care of the Elderly (NPHCE):** The NPHCE aligns with national and international commitments, including the UN Convention on the Rights of Persons with Disabilities, India's National Policy on Older Persons (1999), and Section 20 of "The Maintenance and Welfare of Parents and Senior Citizens Act, 2007" (Verma *et al.*, 2013) ^[62]. A program in India to provide different types of health services for older people, this program aims to give elderly people proper care, from preventing health issues to treating

them. However, there are challenges in making this program work, like making sure there are enough services and creating an environment that supports healthy aging.

- 7. Life Course Approach in NCD Prevention:** Taking care of the health of girls and young women, especially during and before pregnancy. Including NCD prevention in health programs for pregnant women and women in general. This is important because many women and vulnerable groups have limited access to healthcare (Bonita and Beaglehole, 2014) ^[50].
- 8. Global Efforts and UN High-Level Meeting (2011):** Important efforts to address NCDs on a global scale. In 2011, leaders from different countries agreed to take actions to tackle NCDs. They set a goal to reduce NCD-related deaths by 25% by 2025 ('25 by 25'). However, the targets they set lacked considerations for gender-specific differences (Bonita *et al.*, 2013) ^[26].
- 9. Priority Targets and Interventions:** A focused approach to NCD prevention, the Lancet NCD Action Group suggests concentrating on a few key targets (3 to 5) that will have a big impact. This approach includes strong leadership, working together across different sectors, reducing tobacco and salt consumption, and identifying people at high risk of heart disease and treating them with affordable medications (Bonita *et al.*, 2013) ^[26].

Conclusion

In conclusion, non-communicable diseases (NCDs) like cardiovascular diseases, cancer, diabetes, and chronic respiratory diseases pose a global public health challenge. Preventive measures, including addressing modifiable risk factors, promoting healthy lifestyles, early detection, and medical interventions, are essential. Chronic inflammation, oxidative stress, metabolic dysfunction, and epigenetic modifications contribute to NCD development. Global initiatives like the UN High-Level Meeting and the '25 by 25' goal are driving policy changes. Integrating NCD prevention into women-centric health programs and following priority targets outlined by The Lancet NCD Action Group are crucial. With a comprehensive understanding of risk factors and interventions, we can reduce the burden of NCDs globally through healthier lifestyles and integrated healthcare approaches.

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