A review of burden and determinants of cardiovascular diseases and diabetes among the adult population in Yemen

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Yemen

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A thesis submitted in partial fulfilment of the requirement for the degree of Master of Science in Public Health

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Where other people's work has been used (from either a printed source, internet or any other source), this has been carefully acknowledged and referenced in accordance with departmental requirements.
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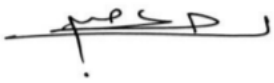

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List of Abbreviations

ACS	Acute Coronary Syndrome
AMI	Acute Myocardial Infarction
CHWs	Community Health Workers
CNS	central nervous system
CVDs	Cardiovascular Diseases
CVS	Cardiovascular System
DALYs	Disability-Adjusted Life Year
DM	Diabetes Mellitus
T2D	Type Two Diabete
EMR	Eastern Mediterranean Region
EPHS	Essential Package of Health Services
GGHE	General Government Health Expenditure
GP	General Practitioner
GDP	Gross Domestic Product
GCC	Gulf Cooperation Council
HFs	Health Facilities
HIS	Health Information System
HeRAMS	Health Resource Availability Mapping System
HHs	Households
HTN	Hypertension
HRH	Human Resources for Health
HNO	Humanitarian Need Overview
HSS	Health System Strengthening
IHME	Institute for Health Metrics and Evaluation
NGOs	Non-Governmental Organizations
LIC	Low Income Countries
MNCH	Maternal, Neonatal and Child Health
MENA	The Middle East and North Africa
m	million
MoF	Ministry of Finance
MoPHP	Ministry of Public Health and Population
NHS	National Health Strategy
NCDs	Non-Communicable Diseases
NGOs	Non-Governmental Organizations
OOP	Out-Of-Pocket
WHO PEN	WHO Package of Essential Non-communicable Disease Interventions
PHC	Primary Health Care
RFs	Risk Factors
SDGs	Sustainable Development Goals
STEPS	STEPwise approach to Surveillance
THE	Total Health Expenditure
UNDP	United Nations Development Programme
UHC	Universal Health Coverage
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNDP	United Nations Development Programme
WB	World Bank
WHO	World Health Organization
YNHDS	Yemen National Health and Demographics Survey

Glossary

Cardiovascular Diseases (CVDs): are "a group of disorders affecting the heart and blood vessels and include coronary heart disease (CHD), cerebrovascular disease (CVD), peripheral arterial disease (PAD), and rheumatic heart disease (RHD) "(1).

Diabetes: is "a chronic, metabolic disease characterized by elevated levels of blood glucose (or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys and nerves. The most common is type 2 diabetes (T2D), usually in adults, which occurs when the body becomes resistant to insulin or doesn't make enough insulin"(2). It is also known as Diabetes mellitus (DM).

Hypertension: is "also known as high or raised blood pressure, is a condition in which the blood vessels have persistently raised pressure". Blood pressure is "created by the force of blood pushing against the walls of blood vessels (arteries) as it is pumped by the heart. The higher the pressure, the harder the heart has to pump"(3).

Risk Factor (RF): "An aspect of personal behaviour or lifestyle, an environmental exposure, or a hereditary characteristic that is associated with an increase in the occurrence of a particular disease, injury, or other health condition"(4).

Biological Risk Factors: are "those relating to an individual's body or biology" (4).

Behavioural Risk Factors: are related to "actions' that the individual has chosen to take. They can, therefore, be eliminated or reduced through lifestyle or behavioral choices such as tobacco use, unhealthy diet, lack of physical activity, and harmful use of alcohol"(5).

Body Mass Index (BMI): is "a person's weight in kilograms divided by the square of height in meters. A high BMI can be an indicator of high body fatness"(6).

Second-hand Smoke: is "the combination of smoke from the burning end of a cigarette and the smoke breathed out by smokers"(7).

The Middle East and North Africa (MENA) region: "includes approximately 19 countries: Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, Palestine, and Yemen. Sudan and Turkey are sometimes included in MENA. These countries are grouped together by international, economic, and academic organizations"(8).

Abstract

Introduction: Non-Communicable diseases (NCDs) are major causes of global deaths and disability, particularly in developing countries like Yemen. Among these diseases, cardiovascular diseases (CVDs) and Diabetes significantly contribute to global disability and mortality.

Objective: This study aims to review and analyse the burden and determinants of CVDs and DM among the adult population in Yemen. Also make recommendations for better interventions for prevention and control NCDs in Yemen

Method: A literature review was done and guided by using the conceptual framework for analysing of NCDs by the World Bank 2008.

Results: There is a scarcity of reliable data and information related to the burden of CVDs, DM and their RFs among the adult population in Yemen. There are many determinants influencing CVDs and DM development. The major determinants are the modifiable factors such as behavioural factors representing by tobacco use, khat chewing and consumption of unhealthy diet. Those factors are interconnected with other determinants like cultural, gender inequalities, economic, low level of education and conflict consequences. The NCDs burden in Yemen is also affected by the endless challenges of the health system, already fragmented before the war and worsened due to the current conflict. Health System Fragmentation adversely affects the NCDs tackling at different dimensions: information and data of NCDs are not integrated into the national HIS; the lack of integrated NDCs services into the PHC. Additionally, weak governance and coordination with other government sectors are dominant in the health sector.

Conclusion and Recommendations:
The burden of NCDs in particular CVDs and DM is a major health issue among adults in terms of mortality in Yemen. This is on the increase and needs urgent intervention. The recommendations of this study were about integration of NCDs services into PHC, support integration of a surveillance system in the national HIS, and multi-sectoral collaboration to tackle NCDs.

Keywords: Cardiovascular diseases, Diabetes, Burden, Determinants, Adults, Yemen.

Word count:12,578

Introduction

Non-communicable diseases (NCDs) are considered as the world's leading causes of ill health and deaths. They are also known as chronic diseases, which are characterized by lasting for a long period, and not spreading from person to person. NCDs are caused by a combination of various factors of genetic, physiological, environmental, and preventable behavioural origin(9). NCDs involve large groups of diseases; however, the main groups of NCDs are cardiovascular diseases (CVDs), cancers, chronic respiratory diseases (CRDs), and diabetes which cause over 80% of all premature NCDs deaths. These disorders are largely linked with preventable common risk factors(RFs), namely, Tobacco use, physical inactivity, the harmful use of alcohol and unhealthy diets(10)(11).

I am a female physician working with a local NGO in Yemen. I am managing the Health and Nutrition Program. I had the chance right after my graduation to touch base with doctors, NGOs, donors and most vulnerable beneficiaries affected by the conflict in Yemen. I have managed the response of maternal, neonatal and child health, breast cancer, Aids and HIV, general humanitarian health services. I have realized during my work the suffering of NCDs during emergencies where; priorities of the government are shifted under the war circumstance, resources are in decline, and the needs of people to be treated of NCDs; including CVDs ,diabetes, and T2D, are with increasing gaps and consequences every day it passes on them. Lack of health workers, proper infrastructures, capacities and well-rounded plans for managing NDCs response, I have realized them increasing the suffering of people. As well, I have witnessed the suffering of most vulnerable including women, elderly which increased needed that is being addressed.

During my work, I always asked a question about the status of NCDs response management in Yemen, the policies, mechanisms, strategies and resources to cover such needs. NCDs response could be improved even in a fragile context like the one in Yemen. Hence, conducting this study will intend to make recommendations for policymaking and service delivery to tackle NCDs issue after reviewing the burden and analysing the determinants of NCDs (CVDs, DM) in Yemen. Moreover, in order to make a good recommendation, this study will review the evidence-based interventions for NCDs prevention and control in Yemen and other countries with a similar context. Accordingly, it brings recommendations for effective strategies and evidence-based interventions for NCDs prevention and control in Yemen.

Chapter 1: Background Information on Yemen

1.1 Geography

Yemen is located in Southwest Asia, at the south-western tip of the Arabian Peninsula (12). It is considered the second-largest country in the Peninsula and occupies an area of 527,970 km^2. It has 22 governorates (provinces) and 333 districts(13). Yemen is surrounded by Saudi Arabia to the north, Oman to the northeast, the Red Sea to the west, the Arabian Sea and the Gulf of Aden to the south, **Figure 1**(14). The country is characterized by a diversity of topography, from the coastal plains in the south and the west, lowlands to highlands in the north and central region, and desert areas in the east. This topographical variation is associated with a diverse climate, which can be classified as semiarid to arid. The rainfall occurs during the spring and the summer (15)(16). The lack of railways and the poor road infrastructure have caused difficulties in the communication, people travelling between those varied geographical areas as well as variations in the cultural characteristics (17).

Figure 1: Yemen Map

Source : International Institute for Democracy and Electoral Assistance (International IDEA)(18).

1.2 Demographic Information

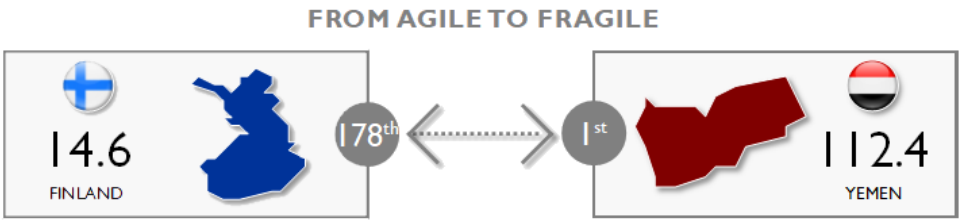
According to the latest estimations of the United Nations in 2020, Yemen's total population is 29,8 million (m) people with an annual current growth rate is around 2.3%(13). This growth rate has consistently decreased since the last years; it has been associated with the depletion of already limited essential natural resources (19). The pyramidal age structure in Yemen shows a predominately young population, the adult population of 25-64 years old are constituted around 11.2 m (37.7% of the total population) and those aged 65 and above, accounted for 2.9% **(see Yemen Population Pyramid, annex 1)** (13). The demographic transition projections indicate that there will be almost a double growing up of the adult population by 2050(13)(20). The life expectancy, at the birth of Yemenis people, is 66 (around 64 years for males and 68 for females), which is still lower compared to other developing countries(21)(22). Yemen's population has a median age of 20.2 years(13). And the total fertility rate is 3.84 births per woman which is lower than in 2010 (5 births per woman). The sex ratio of the population (male per 100 female) is 101.5 (22) (23). An estimated 62% of all Yemenis live in rural and 38%(11,5 m people) in urban areas, which increased in the last years

(13). Major cities such as Sana'a (capital of Yemen) , Al Hudaydah, and Aden are more congested(20).

1.3 Political and security in the current situation

In 2011, the revolution of the Arab Spring took place, it forced president Saleh, who had been in power for 33 years, to hand over his authority to his deputy, Hadi (24). In 2014, the Houthi group, backed by Iran, took control of Sana'a, to start a new cycle of civil war. This time supported directly by outsider international war collation, led by Saudi Arabia(SA), with logistic backup by the USA, who recognize and claim to support president Hadi as the legitimate president(25). The collation operations are economic blockades, airstrikes, humble support of the president Hadi forces, and unfortunately with the creation of multi militias, imposing a foreign agenda and interests rather than retaining Hadi power over Yemen and or achieving peace(26). After six years of war in Yemen, the result of the collations intervention is devastating, as it worsened the already deteriorated situation(27). Despite the liberty of 80% of lands from the Houthie group, the Internationally Recognized Government of Yemen (IRGY), who is in exile at the SA, is not willing to return to Yemen(28). Due to those political events, the country is facing the worst humanitarian crisis and famine .More than 24m people are in need of humanitarian aid and protection from the effects of the economic collapse and destruction of basic lifesaving services(29)(30)(31). And this places Yemen in the top position, for the second time, among the most highly fragile countries and the government relying heavily on grants, just to meet its basic needs, **Figure 2** (32). With the fragmented political and security situation, between war parties, who grow bigger every day, the conflict continues with expectations that it will not have an end soon(33).

Figure 2: Fragile States Index 2020-Yemen.



Source: Fragile States Index | The Fund for Peace(32).

1.4 Socioeconomic characteristics

Yemen is ranked among the poorest countries, with the lowest Human Development Index (HDI) scores, 177th out of 189 countries in 2018 (34). Even before the current conflict, years of mismanagement and corruption and the depletion of oil and water resources had already contributed to lingering poverty, underdevelopment, and minimal access of people to food and basic lifesaving needs (35). The current socio-economic situation is characterized by the extreme growth rate in poverty, population, unemployment and mortality (36). As a result of the ongoing war, the country's GDP faced 49,1 % as a cumulative decline in real GDP between 2015-2018, equivalent to $49.9 billion, which is almost double the size of the entire 2010-GDP (35). The country's local currency faced the highest depreciation in its history, which intensified the burden of life, on poor households (HHs). They turn out to be completely unable to access lifesaving needs, such as food, water, health, and protection, triggering a more severe rate of food insecurity and malnutrition (35)(37).

1.5 Sociocultural characteristics

The official language in Yemen is Arabic. About 99 % of Yemenis are Muslims, and the remaining are Jewish, Christian, Baha'i, and Hindu(38). Social capital in Yemen is primarily made by the tribal association, especially in rural areas and the northern parts

of the county. Others like faith-based institutions, local community solidarity initiatives, civil society organizations (CSO), and support from the diaspora (39). The traditions of community self-help and dispute mediation, show a significant contribution to local stabilization on the community level, the social division caused by the conflict, increases the unequal access to economic benefits, and the restrictions of people's freedom and movement across the country. Concurrently, religious and cultural norms continue to greater gender inequalities, whereas women and girls become more vulnerable than before the conflict(39). This leads to rank Yemen as the least gender-equal society in the world(40). Some of those gender inequities are clear in male dominance in most decision-making, related to the reproductive and overall health of women. In addition to ,concealment of pregnancy by pregnant women and their restrictions to domestic activities and farming, and taking the go-ahead permission first from their male counterparts if they need to go outside the home even for healthcare-seeking (40).

1.6 Education

The literacy rate of young people (15-24 years old) was 90.23% in 2016 in Yemen(41). Youth literacy rates were 97.55% and 82.66% for males and females respectively. While only around 70% of the adult population (aged 15 years and above) can read and write and where most of them are male with a rate of 85.13% and 55.0% among the females (41). The current conflict has caused a non-attendance of schools of 36% of school-age girls and 24% of boys. Teachers' salaries are not paid in 10,000 schools. 66% of the education's infrastructure has been destroyed, as a result of airstrikes or shooting. Recently, more than 2,500 schools are not used (31)(42)(43).

1.7 Health situation and Burden of Disease

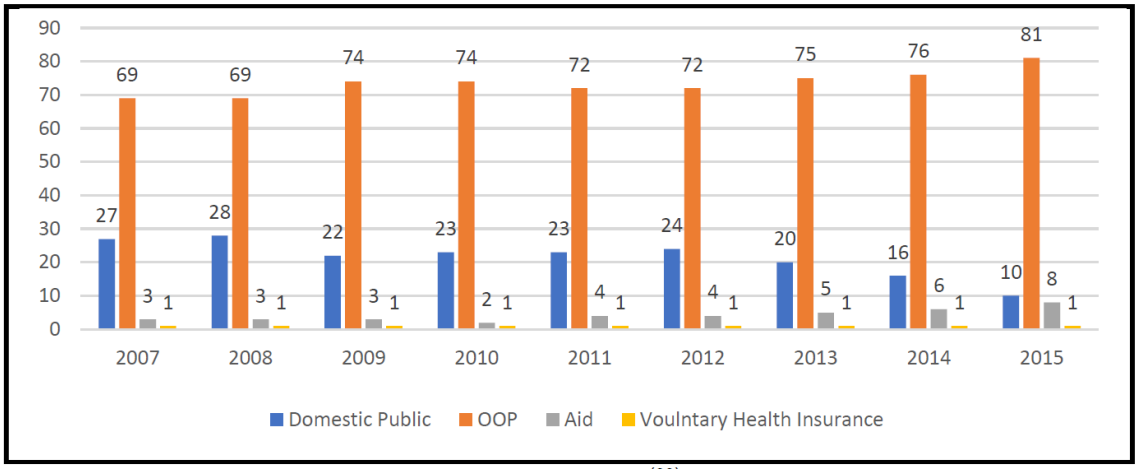
According to the global burden of disease, the main causes of avoidable deaths in Yemen, are communicable diseases and maternal, new-born, and nutritional conditions (together causing 50% of total deaths), and non-communicable diseases (39% of deaths) (44)(45). Additionally, malnutrition is a serious problem, affecting 7.4 million, including 3.2 m people who require urgent treatment for acute malnutrition. Currently, an estimated 19.7m people are in some sort of health assistance and 14 m of these are in acute need of health assistance(29). Nowadays, as the coronavirus pandemic grasps even the most advanced countries, Yemen is in danger with people dying every day(46).

1.8 Health system

The Ministry of Public Health and Population (MoPHP) operates over a four-tiered system of healthcare (primary, secondary, tertiary, and specialized) through the public health sector facilities. The role of the private sector is significantly growing, especially in the current situation and destroying most public health facilities during the war(47)(48). In addition, the informal health sectors (Traditional medicine) is still common in use, especially in rural areas(47). The primary level provides essential health services through primary health care (PHC) facilities distributed nationwide. Secondary, tertiary, and specialized centres are providing services that require high qualifications and more sophisticated services, provided by districts and governorates' hospitals. MoPHP has four sectors: health planning and development sector, population sector, PHC sector and curative medicine sector(47). The curative sector has the mandate to tackle NCDs issues and several programs were established within its structure (47)(48)(49). Yemen's health system is still considered "developing" (50) and is experiencing many serious issues; many of which were even existent before 2015 and worsened by the ongoing war(51). The most important issues are including limited institutional capacity, lack of financing, weak Health information system (HIS) and poor quality of health services. The core functions of the MoPHP, such as regulation, policy analysis and planning, evaluation and monitoring, and management of service delivery, are performed poorly(52). The budgeting and disbursement systems, largely controlled by the Ministry of Finance(MoF), do not serve to reinforce the efforts to promote decentralized planning and management of service delivery at the district level(49)(52)(53). The health financing indicators are

lower than standards for Universal Health Coverage (UHC). As shown in **Figure 3**, the Domestic General Government Health Expenditure (GGHE-D) as % the Current Health Expenditure declined to 10%, while the out-of-pocket (OOP) payment increased to 81% and only 8% from external assistances in 2015(54). Currently, the health system is considerably fragile with only around half of health facilities(HFs), were counted as fully functioning and around 21% of those HFs provide NCDs and mental health services, based on data from the HeRAMS report(55). Medical supplies and health workforce have a chronic shortage (29). There are two ministries(MoPHP) , the MoPHP in Sana'a for the northern governorates and the other in Aden for Southern governorates, this is happened with the division of government into two governments during the ongoing conflict(56).

Figure 3: Percentage of THE between 2007-2015 by Revenue Source



Source: WHO, National Health Account Database, 2016(54)

Chapter 2: Problem statement, Justification, and Methodology

2.1 Problem statement

Globally, the burden of NCDs continues to increase, especially in the Low and Middle-Income Countries (LMICs). In 2016, the WHO reported that NCDs accounted for 40.5 million deaths worldwide and 80% of these occurred in the LMICs(57). In the Middle East and North Africa (MENA) region, NCDs account for 57% of all mortality in 2015(58). Of the NCDs, Cardiovascular diseases (CVDs) and diabetes(DM) account for 43.2% of the total deaths in the region in 2017(59). The IHME data also showed that the disability-adjusted life years (DALYs) from CVDs and DM in 2017 in the region, were 43% and 3.1% respectively(59). The increasing rates of DM, have an alarming patter from 39.9 million diabetic adults in 2017 to 55 million diabetic adults in 2019 and is an indicator of increased prevalence of CVDs, as DM approximately doubles the risk of CVDs development (60)(61) .

The impact of NCDs, including CVDs and DM, transcends beyond the health consequences; it poses substantial detrimental socio-economic effects. Evidence showed that NCDs reduces the household income and welfare by 23.2% (62). The chronic nature of these diseases demands life-long, and expensive treatment increases the healthcare expenditure and the likelihood of catastrophic spending and impoverishment(63). These undermine the global quest for sustainable development, as it hinders poverty reduction, health equity, economic stability and human security(64)(65). In addition, it exerts huge pressure on the health systems, in meeting the demands for service provision; diagnosis and treatment. The NCDs treatment is generally more expensive than other diseases, as they require several engagements with the health system, thus aggravating health financing problems(66)(67). It increases the demand for specialized human resources for health and expensive medical technologies and drugs(63) (66)(67)(68) .

As reported by the World Health Organization (WHO), developing countries, including Yemen, contribute substantially to the CVDs and DM mortality rates in 2011(69). A 2018 UNDP report stated that about 1,800 adults die prematurely every hour, as a result of NCDs in Yemen(70). The deteriorating and fragile state of the health system, due to the impact of the war, which started in 2015, left 19.7 million people without access to adequate health services(29). This has grave consequences for the over 1 million people who will no longer receive the life-saving treatment for NCDs in Yemen(71).

In light of the demographic transition; the aging population and increasing life expectancy, CVDs and DM present a growing public health challenge in the humanitarian setting of Yemen(72). The burden of CVDs and DM has been associated with corresponding behavioural and environmental factors, which change with time. These factors predispose to these diseases and the lack of national surveillance and population-based surveys on NCDs creates a wide gap in understanding the general picture of the burden and risk factors among the adults in Yemen.

2.2 Justification

The prevention and control of NCDs are fundamental in improving population health in Yemen. Since health is a human right, efforts to address NCDs contribute to the achievement of the Sustainable Development Goals and the Universal Health Coverage. Despite the high impact of NCDs on the population's health, economy and health system, there is little attention from the government and humanitarian donors, towards tackling NCDs in the country(73)(49). Meeting emergency health needs of highly vulnerable

people, with chronic non-communicable illnesses, should be a priority, at both policy and operational level (73) to prevent excess morbidity and mortality.

The main NCDs are contributing to the global mortality rate and are comprised of CVDs, DM, cancers, and CRD. This study will focus on CVDs and DM, because of their interlinkage and common RFs. In addition, a quick review showed a lack of studies on CRD and cancer-related determinants.

Although all the age groups are vulnerable to CVDs and DM, the adult population faces a higher risk, because of their exposure to environmental and behavioural factors, related to the diseases(74). There is a need to understand the burden and determinants of CVDs and DM, among this category of people. This is paramount because of the significant proportion of this population group in Yemen and their productivity and contribution to the country's economy.

Tackling NCDs, particularly CVDs and DM in Yemen, requires evidence-based interventions. There is a need for nationally generated data which currently is lacking in the country. This study will review and analyse the burden and determinants of these diseases among the adults. Findings from this study will be used to make recommendations, for implementing effective interventions to prevent and control NCDs for better health outcomes.

2.3 Study Objectives

2.3.1 General Objective

To review and analyse the burden and determinants of CVDs, DM in Yemen, in order to make recommendations for policymaking and service delivery to tackle the NCDs issue.

2.3.2 Specific Objectives

1- To review the burden of NCDs (CVDs, DM) in Yemen.
2- To describe and analyse the determinants of CVDs and DM in Yemen.
3- To review evidence-based interventions for NCDs prevention and control in Yemen and other countries with a similar context.
4- To make recommendations for effective strategies and evidence-based interventions for NCDs prevention and control in Yemen.

2.4 Methodology

2.4.1 Research strategy

A literature review was conducted via searching in the Vrije University (VU) online library, PubMed, Medline databases, Google, and Google Scholar. Grey literature, national policies, surveys, and reports from national and international websites such as MoPHP, WHO, WB, United States Agency for International Development (USAID), and United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) were used. The technique of snowballing was also used for collecting more information. Keywords used in the study include; "Non-communicable diseases", "Burden", "Determinants", "Yemen", "Cardiovascular disease", "Diabetes", " Type 2 Diabetes" "Best practices", These words were searched separately and in combination by using logic connectors (OR/AND) to achieve the study objectives. Other keywords are in **Table 1**.

The Search Inclusion criteria for the selection of studies and grey literature were as follows: 1) grey and peer-reviewed, qualitative and quantitative studies published between 2000-2020, as this period is aligned with many political changes, that affected the health system and country health profile. 2) Studies mainly focus on the burden, determinants of CVDs and DM. 3) Studies among the adult population .4) Studies done in other countries with a similar context of Yemen, were used in cases of the lack of information for some determinants of NCDs in Yemen. 5) in both English and Arabic languages (English was the main language for searching, while Arabic was used to access national data that is unavailable in English copy).

Table 1: Table Research strategy:

Objectives	Sources	Type of source	Keywords
Objective1	Scientific publications Peer-reviewed Literatures Grey literature	VU Library PubMed, Medline Google Scholar, Google Survey, Report, Fact sheets, bulletins.	NCDs ,CVDs, DM, Morbidity, Mortality, Prevalence, Cost, Burden, Deaths, Cases, Double burden, Economic Burden , Yemen, MENA ,EMR ,Middle East, LMIC, Globally
Objective 2	Scientific publications Peer-reviewed Literatures Grey literature	VU Library PubMed, Medline Google Scholar, Google Survey, Reports, Websites: WHO, MoPHP, NGOs reports, UN agencies	Age, Sex, Genetic Factors ,Family history ,Obesity, Tobacco, Physical activity, Diet, Khat chewing, Socioeconomic status ,Poverty ,Gender, Stress ,Culture, Religion, Conflict, Access to health care, Health care financing, Policy, Strategy, Yemen, Arab countries, Syria, Iraq, Palestine, Developing countries, Afghanistan ,Somaliland ,Ethiopia
Objective 3	Scientific publications Peer-reviewed Literatures	VU Library PubMed, Medline Google Scholar, Google ,WHO, MoPHP	Taxations, Multi-sectoral approach, Salt reduction, Tobacco ban, Smoking ban, Regulation, Health promotion programs, Tax, Policies, Strategies, Risk factors reduction, Khat ban Trade, Markets, Conflict areas, The Middle East, Developing countries ,Arab countries ,Afghanistan ,Somaliland ,Ethiopia, Syria, Iraq, Palestine

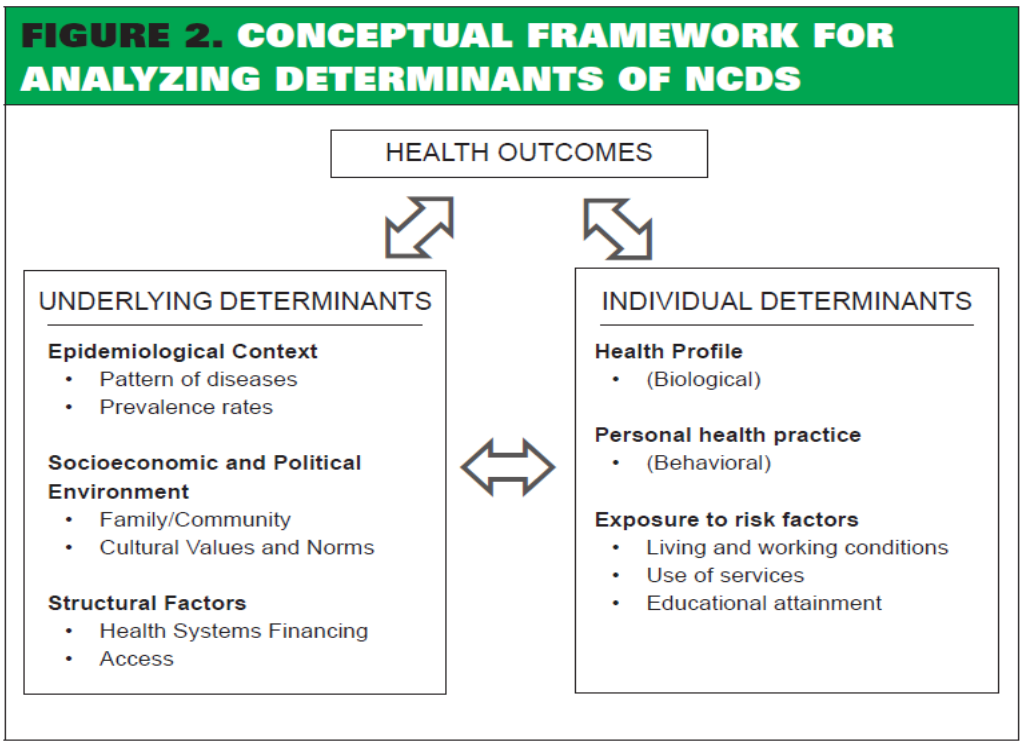
2.4.2 Conceptual Framework:

This study utilized the WB 2008 framework to systematically describe and comprehensively show interactions among the different identified determinants of NCDs, **Figure 3**. The framework was also used to assess the extent and impact of policy interventions on NCD outcomes. According to the framework, NCDs determinants were categorized into two: individual determinants and underlying determinants. The individual determinants influence a person's health and contribute to the risk of developing NCDs at a micro-level while the underlying determinants represents the factors contributing to the risk of the NCD at the population and broader macro-level. The underlying determinants include cultural and socio-economic, health system, political, financing and policy factors(75) .

This framework was preferred to other frameworks such as the NCD pyramid which had little focus on individual factors(76) and Dahlgren and whitehead model which focused primarily on the health services within the health system and not on other health system factors(77).

The categories of this framework were expanded by more details of types of factors.To facilitate the analysing the factors according ordered sections, as illustrated in **Figure 7**.

Figure 4: A conceptual framework of World Bank 2008.



Source : World Bank conceptual framework for analysing the determinants of NCDs (75).

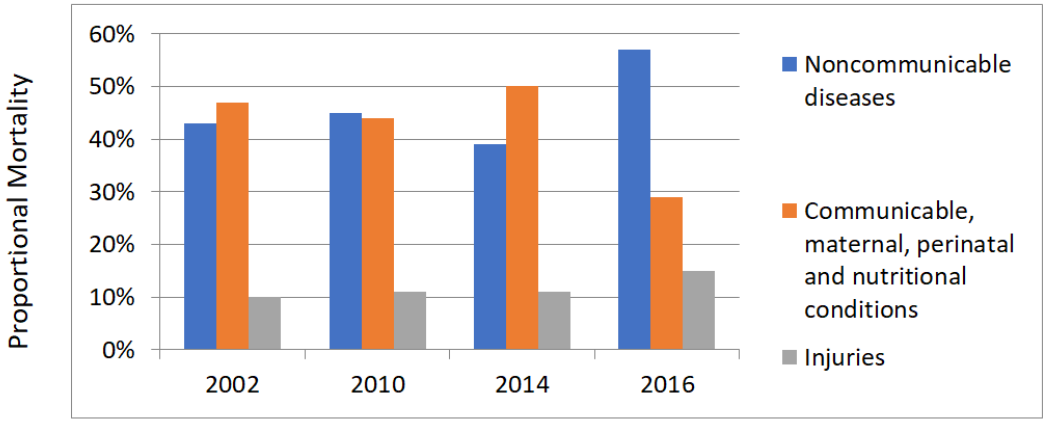
Chapter 3: Results

3.1 The burden of NCDs (CVDs, DM) in Yemen

In spite of a lack of national data on NCDs, the following findings from international and local reports and studies, on the burden of NCDs, in particular, CVDs and DM .This information showed that NCDs are considered a major public health issue in terms of mortality and disability in Yemen:

According to WHO estimates[1], NCDs –related deaths in Yemen are 63,500 people per year (78). In 2016, NCDs including CVDs, DM, cancers, and CRDs, did account for 57% of total of 174,000 deaths (79). This proportion increased since 2002, where NCDs constituted 43% of total deaths, **Figure 5** (80)(81)(82). Additionally, estimates showed that premature mortality (YLLs) from NCDs, among females and males, was 48,600 and 49,900 respectively. The total risk of dying, between ages 30 and 70 years, from the four main NCDs in 2016, was 31% (more in males with 33% than only 28% in females(79).

Figure 5: Deaths by cause, all ages, Yemen



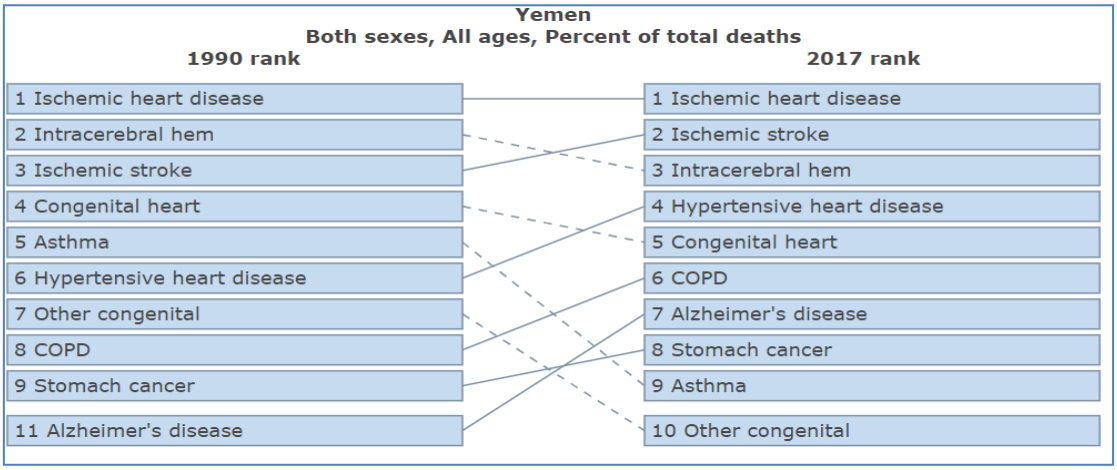
Source: Based on available data from WHO *non-communicable Diseases* (NCD) Country *Profiles-Yemen*,2002,2010,2014,2016 (79) (80)(81)(82).

Cardiovascular diseases (CVDs):

CVDs are ranked as the first cause of the Yemenis population deaths, by the percentage of 33% in 2017, after they caused 19% of total deaths in 1991(83). **Figure 6** shows that CVDs were among the top 5 causes of premature mortality, related to NCDs deaths, comprising of ischemic heart disease (19.7%), ischemic stroke (5.2%), intracerebral haemorrhage (2.87%), hypertensive heart disease (2%) and congenital heart disease (1.83%) (44).

[1] WHO estimates are "based on country revised life tables, cause of death models, regional cause of death patterns, and WHO and UNAIDS program estimates for some major causes of death (not including NCDs)"(219).

Figure 6: Top 10 causes of premature deaths related to NCDs in Yemen



Source: Global burden diseases-Yemen, IHME,2017 (44).

Based on the IHME data, it showed that the overall prevalence of CVDs in Yemen was 3.7% in 2017 and this was below the regional average of CVD's prevalence of 5.6% (83). Hypertension (HTN) is the major contributor factor for CVDs(3) (84). A study conducted in Sana'a in 2008, it showed in Yemen that among the age group 15-69 years, the prevalence of HTN was 7.7%(85).In 2015, WHO estimates of the prevalence of HTN among adults 18 and above in EMR emergency countries, indicated that HTN prevalence in Yemen was 30, 6 %, which was high compared to the regional average prevalence of 27.8 %**(see annex 2).**

While there are gaps in national estimates, there is the availability of scattered facility-based data, through annual reports of diseases per governorates. Those figures do not tell a lot about the general picture of burden of CVDs .For instance, according to the Annual Report of Disease of 2018 of Sana'a city, it showed the total admissions to the cardiac center of Althawrah General Hospital, were 2295 cases and 1780 cases undergo a diagnostic catheterization. This report did not give other details about types of CVDs and the number of surgeries(86).

A consultancy report for MoPHP revealed that the available data of CVDs remains underestimated in Yemen. And this underestimation is due to poor documentation, a weak information system and scarce researches and their funding in the country(49).

Diabetes:

Diabetes attributes to 2% of the total deaths of Yemenis in 2016(79). Its prevalence among the adults is around 4%, with 572,700 total cases of diabetic adults, according to the International Diabetes Federation(IDF) and data of 2020(87). A similar figure was found, based on data of IHME in 2017(83). This prevalence rate is considered lower than the MENA region prevalence, which was 7% and is expected to dramatically increase in the upcoming decades, alongside an increasing prevalence of RFs in this region. The prevalence of the raised blood glucose, which is RF for DM, was 8% among adults aged 18+ in 2014(79). A study was conducted in a semirural area near Sana'a Governorate, showed that the prevalence of DM was 10% and the age-standardized rate was 6.3% (95% CI: 5.4%–7.2%). The age-standardized rate, of having either impaired fasting glucose or impaired glucose tolerance was 9.0% (95% CI: 6.0%–12.0%)(88).

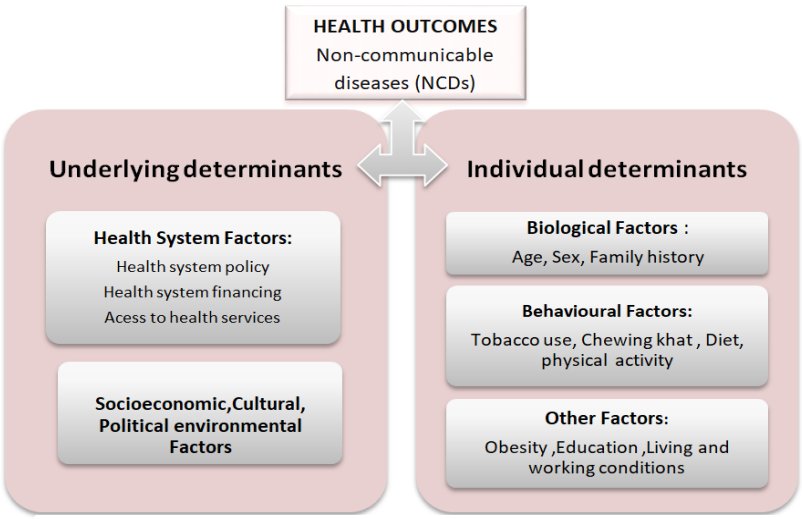
To summarize that information, although these studies do not reflect the global picture of the CVDs, DM in Yemen, it shows how serious the situation is in comparison to developing countries in the region such as Sudan and Pakistan(67).

No studies have been conducted, to assess the cost and the economic burden of NCDs in Yemen; global research as mentioned in Chapter 2, indicates the large and growing costs of NCD for individuals, families, societies, and nations(89). NCDs pose a tremendous economic burden, as the NCD's diagnosis and treatment costs, even in the public sector, represent a substantial economic burden, that can result in catastrophic expenditures (90) (91).

3.2 Determinants of CVDs, DM

This chapter will describe the determinants following the elements in the visualized model (figure X).

Figure 7: A visualized model



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3.2.1 Individual Determinants

3.2.1.1 Biological factors

3.2.1.1.1 Age

Age plays an important role in increasing the risk of NCDs including CVDs and DM. As aging is a biological process in the population, it correlates with the onset of diseases or can exacerbate several ill-health conditions(92). This is a result of a decline in the performance of most body organs functions, combining with cumulative exposure to other RFs related to behaviours and lifestyle changes, both cause alterations in the physiology and metabolism processes of cells, thus increasing the risk of NCDs developing(92)(93). The main NCDs and their intermediate-risk factors, that are associated with population age, are HTN, DM, obesity, dyslipidaemia, metabolic syndrome, and cancers (2)(94)(95). Studies in Yemen showed that age was significantly associated with the prevalence of DM, and HTN. A cross-sectional study, conducted in Sana'a city among 498 adults aged 25–65 years, where the prevalence of DM (either diagnosed or undiagnosed), impaired fasting glucose, and impaired glucose tolerance (IFG/IGT) among the respondents was found to increase with age (96). Similar findings were found in another study conducted in the semirural area of Hamdan among people aged 35 and above. In addition, it was reported that the prevalence of HTN(either diagnosed or undiagnosed) increased with age(88). People 40 years or older were found to be more at risk compared with those in the other age groups(97)(96)(98). Based on IHME data ,the prevalence rates of CVDs and DM among those aged 50-69 were 19% and 17%, while the rates were 42% and 24% in those aged 70 and above respectively(83). These age groups, as mentioned in the background, represent a significant proportion of the total population(99). There was no data to show proportions of older people in urban or rural areas. Evidence found that the prevalence of major RFs of NCDs, like behavioural and lifestyle factors and obesity, was higher among older persons(100)(101)(102).In addition to low literacy rate among older groups, with less

awareness of the severity of NCDs(41). All these factors synergistically increase the risk of NCDs developing in older adults.

3.2.1.1.2 Sex

Men and women have a roughly similar risk of developing NCDs during their lifetime (103)(104). Women have a lower risk of CVDs such as Myocardial infarction (MI) due to premenopausal protection they get from female hormones which effect on lipid metabolism. Decreasing lipid deposits in blood vessels and CVDs(105). Findings of studies conducted in Yemen showed no association between the sex and prevalence of CVDs and DM (106)(17). A different finding was found; it indicated that there was an association between sex and NCDs such as HTN and DM. The prevalence of HTN was higher in men compared to women, while women had a slightly higher rate of DM and IFG/IGT (88). This is related to gender differences, which are associated with a different prevalence of RFs of NCDs (more details in the section **3.2.2.1**).

3.2.1.1.3 Family history of CVDs, DM

A positive family history (FH)is a strong non-modifiable RF for developing CVDs, and DM (107). FH is considered a genetic risk predictor (108)(109). It is known that having FH of a common chronic disease, increases the risk of developing these conditions by 2 to 5 times, and this risk increases with the number of affected relatives (110). A survey conducted in the Hamdan district in Yemen, among adults aged ≥ 35, reported that FH of DM and HTN among first-degree relatives was prevalent among the study sample(88). Another recent study in Sana'a city, among 500 diabetic adults, showed FH of DM was a strong RF for T2D, with a familial risk, likely to be around 2.4-fold, as opposed to those patients with negative FH (88). It was found that offspring with consanguineous and/or conjugal parents with DM are more at risk of early-onset T2D development(88).

Some genetic traits such as high sodium-lithium counter-transport, low urinary kallikrein excretion, elevated uric acid level, high-density LDL sub-fractions are associated with a higher retention of sodium, high LDL cholesterol , risking in HTN and other CVDs development (111) . The interaction of these genetic traits with lifestyle, behavioural, and environmental factors, will increase the individuals' susceptibility of risk CVDs and DM (112).

3.2.1.2 Behavioural factors

The CVDs and DM share common behavioural RFs such as tobacco use, unhealthy diet, lack of physical activity and harmful use of alcohol(11). Alcohol consumption is not common and people are inhibited to drink alcohol in Yemen as it is an Islamic country(113). Instead of that, khat chewing is a popular behaviour in Yemen, and will be covered under section **3.2.1.2.2**.

3.2.1.2.1 Tobacco use

Overall tobacco use in Yemen is common. According to the WHO, global tobacco epidemic data of 2017, the estimated prevalence of any tobacco use among those aged 15 years or more, was 21.3% among both sexes, while tobacco smoking prevalence was 17%(28% in males and 7% in females)(114)(79). The common behavioural habit of cigarette smoking, Shisha (water pipe) use has also increased, including among young people of both sexes(114). No available data was found about E-cigarettes.

Tobacco use significantly contributes to the increase of risk of NCDs development (115)(116). The toxic chemicals of tobacco smoke, like nicotine, carbon monoxide (CO), and oxidant gases, are the potential contributors in the pathogenesis of CVDs(117)(118). There are multiple pathophysiological mechanisms, through which the tobacco causing CVDs, include damaging the lining of the arteries(119), increasing myocardial oxygen demand (O2), platelet aggregation, inflammation(120), insulin resistance, dyslipidaemia, and a hypercoagulable state (121)(122). It has been found that tobacco smoking is RF for developing T2D and its complications (123). Through enhancing insulin resistance, dyslipidaemia, and central obesity; smoking increases the risk of these diseases(124). The exact mechanism, by how smoking causes insulin resistance, is not fully established(124)(121).

Studies done in Yemen show that association between tobacco smoking and NCDs is limited. A retrospective study carried out in only one hospital in Sana'a, among 386 patients with acute myocardial infarction(AMI), who were mostly men(90%)and their ages ranging between 27-82 old years, found that the prevalence rate of smoking among those patients was very high (81%)(125). Another cross-sectional study was conducted among 450 rural women in the age range from 18 to 60 years, who were present in the targeted health centres of Sana'a and Al-Mahweet governorates during the time of the study. This study showed that smoking was significantly associated with obesity and had no relation with high BP and DM(97). A study in Ethiopia found that the smokers have an as high as three times risk of developing HTN compared to those who never smoked cigarettes (126). Another study showed that the risk of T2D developing among smokers was statistically higher than for non-smokers, after controlling the socio demographic, behavioural, metabolic, and HTN-related factors(127).

A cross-sectional study performed among students at Hodeidah University, in Al-Hodeidah district, showed that smoking prevalence increased considerably with age of student and years of study. As those over 24 years old and in the third and fourth year were the most frequent smokers, this was attributed to decreasing of family pressure on stopping smoking in the older youths and peer pressure in the university environment, thus influencing their smoking attitude (128). Another survey in a rural area of university students found that smoking rates were 25% for male and 12% for female students (129). This high prevalence of tobacco smoking rate among students may be attributed to many other factors including the lack of awareness or comprehension of smoking threats to health, the sales advertising by tobacco commercials, and low socioeconomic status(128). The conflict setting is the main contributor in increased tobacco smoking due to people exposure to excessive and chronic stress levels, the results of displacement and physical endangerment, thus probably to engage such behavioural factor are related to NCDs(130).At reginal and national level, the water pipe use is still growing, especially among young people of both sexes and adolescents(131). Evidence linked this to several factors, including the social acceptance of water-pipe smoking, especially women; the misperception that water-pipe smoking is safer than cigarette smoking. In addition to the increase of availability of coffee shops, which deliver water-pipes for both men and women; and the absence of legislation to control water pipe smoking in public(131).

Evidence found that it is commonly concurrent tobacco smoking with khat-chewing sessions(132). Exposure to environmental tobacco smoke (second-hand smoke) also poses a major cardiovascular health threat. Second-hand smoke increases the risk of CVDs developing by 25–30%(133) .

3.2.1.2.2 Khat Chewing

Studies conducted in Yemen showed that khat is a significant RF for many CVDs, including heart failure(HF), stroke, acute myocardial infarction (AMI), and acute coronary syndrome (ACS) (134). Khat is the name given to the leaves of the plant Catha edulis and contains cathine, cathinone and norephedrine, which are amphetamine-like chemicals which are responsible for its effects on the central nervous system (CNS) and cardiovascular system(CVS) effects (135). The effects of these active ingredients on the CVS are expressed through an increase in heart rate (HR), blood pressure (BP), vasoconstriction of the coronary vessels and are weakening the cardiac muscle contractions, therefore developing CVDs (135). Both the quantity and duration of khat use are important elements influencing the development of CVDs (136)(137)(138). People, who regularly chew khat, had high BP and HR in comparison to non-khat chewers (19). Motarreb et al.(136) found that heavy khat chewers were 22 times more likely to develop AMI. This is attributed to high blood concentrations of cathinone with regular khat use, which causes severe coronary spasms that contributes to the development of AMI(134)(137).

Studies also showed that there is a relation between Khat and the risk of T2D development. A prospective controlled study among 340 Yemenis of both sexes aged 15 to 80 years, found that almost all of the exposed group of (127 chronic Khat chewers(CKC) had non-insulin-dependent DM(139). This result was explained as it might be due to the long term effects of pesticide residues on CKC. *Dichlorodiphenyltrichloroethane (*DDT*),* one of pesticides components, influences carbohydrate metabolism through several mechanisms which induces high blood glucose (139).Therefore developing DM.

Khat chewing is a common practice across citizens of East Africa and the Arabian Peninsula, which spreads worldwide as a result of globalization, delivery systems, and immigration of khat chewers. It is most notably in Ethiopia, Somalia, and Yemen(139). In Yemen, the prevalence of khat chewing for the whole population is 68% (80.0% of men and 60.0% of women)(132). People chew Khat for its stimulant effects on the CNS (140)and their belief of its role in euphoria and relieving stress (97). Almost all Yemenis males chew khat with noticeably an increase among women and school-age children in recent years with the war persistence (114)(141)(142). This has been linked to a high unemployment rate, lowest wealth quintile, lower levels of education, depressed living conditions, family dysfunction, wasting of time and cultural factors (143)(144).

A cross-sectional study was conducted among 692 adult women in Sana'a , showed that the prevalence of chewing khat by women was 30%. This was significantly attributed to encouragement of their husbands for sharing khat sessions. Others are family factors, like frequent family social gatherings, high family income, larger house, and age of women (145).

3.2.1.2.3 Diet

Studies showed that the type, pattern, and amount of diet influences the risk of developing NCDs. Consumption of adequate fruits and vegetables is protective against CVDs and DM. Fruits and vegetables contain various nutrients that can prevent or control the metabolic RFs of NCDs(146). For example, macronutrients and micronutrients such as potassium have been demonstrated to lower the high BP and cholesterol, which are RFs for coronary heart disease and stroke(147). The intake of high levels of salt, fats, carbohydrates and soft drinks are linked with an increased risk of CVDs and DM(148)(149)(150). Evidence shows that high dietary salt intake, increases sodium levels in the blood and subsequently causes elevation of BP, thus the risk of CVDs(151). Diets with high levels of fats, carbohydrates, and low fibres have been shown to deteriorate glucose tolerance in the blood, by several mechanisms, including decreasing binding of insulin to its receptors, insulin resistance, impaired glucose transport, and dyslipidaemia(152)(153). This contributes to the risk of developing NCDs (DM, CVDs).

Data related to vegetables and fruits consumption among the Yemenis is very limited. A study showed that there was a low daily consumption of fruits and vegetables among rural women (only 19.5%,39.0% respectively)(97). Findings from a cross-sectional study, conducted in five districts of Somaliland, found that the prevalence of fruit and vegetable consumption was very low in both sexes(154). According to the report of regional STEPS surveys revealed that 79–96% of adults in Arab countries are eating less than the recommended of five daily servings of fruit and vegetables(155)(156)(157). The low fruits and vegetables consumption in LICs has linked to limited access and economic obstacles to get vegetables and fruits ; those kinds of food usually have high costs relative to other foods(154). In addition to other determinants like cultural and environmental factors, more explanation in section **3.2.2.1**.

In the recent years, the lifestyle of Arab countries, including Yemen, has fundamentally changed due to globalization, worldwide trade and marketing.Resulting in the Arab traditional high-fibre and low-fat foods being replaced with high calories and salt diets like refined, processed foods, and fast food, alongside with a sedentary lifestyle, obesity, and lack of physical activity (33). All those are associated with the risk of CVDs and DM. Based on WHO estimates, the mean salt intake, among adults aged 20 and higher in Yemen was 9 grams per day (g/d) which is higher than the WHO's recommendation of less than 5 g/day per person for adults(79). There is a link between diet and unhealthy diet practices and others, like education, gender, and cultural practices like khat chewing(158) (more details in the sections **3.1.3.2, 3.2.2.1**).

3.2.1.2.4 Physical Activity (PA)

There is association between level and pattern of PH and the risks of NCDs developing. Regular and adequate PA, as recommend by WHO[2], is a preventive factor against CVDs and DM, while the insufficient PH is associated with increased risk of CVDs and DM by 20-30% (159)(85)(160). The energy expenditure through PH contributes to reduce the body fats. This will prevent the weight gain/ overweight and obesity, which are the main causes for many NCDs including CVDs and T2D(161)(162).

[2] WHO recommends adults aged 18-64 years to do "150 min of moderate-intensity physical activity per week, 75 min of vigorous-intensity physical activity per week, or equivalent"(220)

No data is available about PA among the adults and its effect on the NCDs developments in Yemen, one study was conducted in Yemen among rural women. It found that working of women in housework as well as in the farming as physical activities contributed to lowering the levels of obesity, high BP, and DM (97). Evidence from data in Arab countries, including Yemen, showed that low physical activity among citizens are attributed to the limited number of sports centres in rural and urban areas, and the absence of physical education programs for girls and boys(68)(97). The cultural reasons include families not to encourage females to engage in physical activities and make social barriers for them, to exercise outside the home without a family member for safety and security (155)(68)(97). This contributes to increasing the levels of physical inactivity and the risk of developing NCDs among communities. In context of Yemen, conflict decreases the ability of people to go out for exercise, but even before war people were not used to regular exercise.

3.2.1.3 Other factors

3.2.1.3.1 Obesity

Obesity substantially increases the risk of NCDs such as T2D, hypertensive disease ,stroke and others (163)(164). It is defined as " abnormal or excessive fat accumulation that might impair health"(165). Adults tend to be overweight if their BMI measurement is ≥25; while BMI ≥30kg/m2 means they have obesity(165). A raised BMI mainly occurred due to an energy imbalance between over consumption of calories from unhealthy diets (high levels of fats and sugars) and too few calories burned/expended that is associated with physical inactivity(166)(165). The primarily pathological mechanism of obesity, in causing the common NCDs, is chronic low-grade inflammation due to increased leptin levels and oxidative stress. Accumulating fat mass in cells causes insufficient functionality of important organ systems and contributes to NCDs(167). Based on WHO estimates of 2016, the prevalence of obesity among those aged 18 and above in Yemen was 14% for both sexes, 10% for males and 18 % in females. While prevalence of overweight was 48.4% for both sexes in that year(79). The significant association between the obesity and NCDs, such as HTN and DM, has been shown by different studies conducted at different levels (urban, semirural, rural areas) in Yemen. A study conducted in Sana'a city among 498 subjects aged 25–65 years found that obesity was prevalent among the diabetics' patients and those with IGT, as well as its prevalence in females. This was 1.6 times higher than males of study participants(96). Similar findings found in a survey performed among urban and rural adults aged of 15-69year, found that obesity, abdominal obesity and high cholesterol were more prevalent in women than men.While obesity prevalence was higher among urban residents, compared to those living in rural areas. No difference according the geographical levels (17). This was related to the effect of urbanization on nutritional shift to unhealthy foods and sedentary lifestyle(17). Another cross-sectional, primary-care based study found that the mean BMI was associated to increasing of age, with a peak in the age group 35–44 years. Overweight prevalence was higher among males than females (18% vs 14%). While 12.4% of females and only 2.5% of males were obese(168). Evidence demonstrated the relation between obesity with other determinants, such as level of education, socioeconomic status, genetic susceptibility, and environmental factors(149) (more details in other sections) .

3.1.3.2 Education

As mentioned in the background, only around 70% of the adults are literate. The lower level of education has been linked to risks of NCDs (169)(170)(97). Lack of education

influences the use of traditional medicine or non-medical products and an unhealthy diet consumption may contribute to the risk of NCDs(88). Across-sectional study found a strong association between the low educational level and CVDs, DM, and obesity development among rural women in Yemen(97). This was linked with loss socioeconomic status, living in rural areas as well as cultural practices of khat chewing, and less perception of the NCDs severity, which will prevent care-seeking. Based on YNDHS, it reported that uneducated men were most likely to smoke (29%)(144), so they are more exposed to the risk of NCDs development.

3.1.3.3 Living and working conditions

Results from a large scale population-based, cross-sectional study, covering 10,242 participants aged 15-69 years, at the level of 3 different geographical areas (capital area, inland, coastal area), showed that there was no statistical significant association between HTN and rural or urban residency. The HTN prevalence rate was highest in the coastal areas compared with inland and the capital area (10.1%, 7.9% and 6.4% accordingly) (17). This was explained as result of the remoteness of the coastal area of Yemen, being sparsely populated with poor living conditions and limited resources, in particular the health services. This contributed to the developing of HTN (17). In contrast to that, DM and abdominal obesity and high cholesterol were more prevalent among urban than among rural residents and did not differ between the geographical areas(17). This was explained by the consequences of urbanization on people shifting to western diet and sedentary habits and stressful life of the following urbanization(17). Based on findings from international studies it showed the merits of urbanization, it has been reported by improving access to health care facilities, increasing education level and health literacy and awareness of such diseases(171).

The work status and work environment are a significant influence on the risk of NCDs among adults(97)(172). This is related to the safety of work environment and behaviours, through physical and psycho-social mechanisms, associated with work conditions, which eventually associate with risks of NCDs development(97)(172)(173). Evidence revealed that early life exposure to work environmental risks, like air pollutants ionizing, UV radiation, and chemicals, such as pesticides, asbestos, increase risk of NCDs, such as CVDs(173). Interestingly, a study in a rural area in Yemen found that women, participating in agricultural work, had a protective factor against developing HTN and DM (97). Unemployment and related low socioeconomic status in urban areas are highly associated with NCDs risk(174). The Conflicts effects on the economy collapsing and high unemployment rate, increasing stress and psychosocial disorders as well as poor income(175); expose the adults to risky behaviours. Therefore the risk of developing NCDs .

3.2.2 Underlying Determinants

3.2.2.1 Socioeconomic, cultural and political environment

Evidence has revealed the linkage between the socioeconomic situation and NCDs risk over the LICs(173)(176). Findings from a study in LIC, found that poorer people are most vulnerable to NCDs such as CVDs and DM(176). This has been explained by many factors, including, lack of access to education, healthcare services, markets for nutritious food, psychosocial stress, higher levels of risky behaviours, and unhealthy living conditions (173)(176). Poorer people are less likely to look for preventive and screening services for NCDs. If they are diagnosed with diseases they are less able to afford

medicines and treatment. On the other hand, a study conducted among 54 LMICs, showed that positive association between high income and overweight/obesity (174). This was a result of the ability to easily access western food and using cars and technological machines, consequently less physical activity. As mentioned before, there are several economic challenges in Yemen. The current economic collapse, that was exacerbated by war and political instability, has been associated with an increasing rate of poverty and unemployment, insufficient essential public services provision as well as the difficulty to basic needs (36). This situation has caused an increase in goods prices, inflation, and currency devaluation(35)(37). All these have resulted in financial hardships for many people who are living in poverty. It estimates that the daily per capita income of most adults of the working –age group is less than $1.90(29) .Moreover ,Yemenis spent daily around 50.0% of their HHs income on khat (132). All these tend to significantly contribute to risk NCDs development in the community.

Factors related to Culture, religion and gender inequalities demonstrated to contribute to risk of NCDs(177) . There are some of cultural practices that can be harmful or result in negative health consequences. Khat chewing is a common social habit among the Yemeni community. It is a part of a daily social life. It is an essential part of social gatherings and events. Many people chew it on a daily basis, mostly in the afternoon and evening periods(132) (178). Almost all Yemenis males chew khat with a noticeably increase among women and younger groups of the community (114)(141)(142).It is believed by many people that khat has a beneficial effect on reducing the blood glucose in diabetic patient(139) . Smoking of men is also culturally considered as part of masculinity. Most of women are also affected by the cultural and religion roles, they can't go out to exercise or even to HFs without permission or companying men with them. Also they are less access to education and decision -making power(175) .
These cultural, religion and gender inequalities lead directly or indirectly to increasing the risk of developing NCDs .This Links with low level of education, using non-medical products like herbs and risky behaviours, as was discussed previously.

The long history of political instability and civil war in the country has caused a deteriorating health system and delay progress in implementing the political commitments for improvement of the population heath(51) .The ongoing conflict has caused one of the worst humanitarian crisis in the world(29). The most substantial by-products of this crisis include nearly 1.5 m people lost their lives, more than 20 m people are food insecure, and millions cases of malnutrition. Additionally, 17.8 m persons lack access to clean water and sanitation, and around 20 m people lack access to healthcare. An estimated 300,000 people has displaced(29). It is also causing extensive destruction to public and citizen infrastructure(179). Governorates such as Taizz, Al Hudaydah and Sa'ada ,are the most affected by the conflict with over 60% of people are in acute need for humanitarian assistance(29).

The actual effect of conflict on NCDs risk has not been studied in Yemen. However, based on the annual report of disease, the number of reported new cases of DM was higher in the conflicted areas, compared to non-conflicted states. For example, Sa'adah district had 19,215 new diabetic cases in 2018, while Al-Mahweet (non-conflicted district) had reported only 40 new cases in that year (86).The ongoing war has increased the magnitude of health needs ,and at same time decreased its health system capacity(29). This leads to disruption of healthcare provision, malnutrition, physical injuries and underlying stress responses and it's associated with increasing of risky behaviours.

Additionally, the availability of medical supplies has affected by economic sanctions and blockades (29).The negatively impact of conflict have mainly found among internally displaced people (IDP),women, disabled and elderly people and some groups like the Muhamasheena and marginalized ones (39)(180). Thus increasing their exposure to risk of developing NCDs and its complications

3.2.2 Structural factors

3.2.2.1 Health System Policy

Currently, the country has two governments and in parallel to that two ministries of health. There is no information available that describes how both ministries are working to tackle NCDs and other health problems. The information presented in the following paragraphs was collected from a combination of documents before and after the war.

There is no strategic framework, specifically for tackling NCDs in Yemen yet, there have been some policies developed to address the RFs for NCDs. For example, the policy on tobacco use control (181). The National Health Strategy and Plan 2010-2025((NHSP) entails Yemen's trajectory in regard to its vision, budget, plan and strategies towards ensuring the providing of sustainable, good quality of comprehensive health services(48). Policies on NCDs have not been merged with this overall comprehensive strategy as well as integrated with the country's operational plan. The implementation of this strategy has been stalled due to the longstanding war that has ravaged the country since 2015(182). **Table 2** shows some policies, activities and several joint statements and charters with other Gulf countries which were carried out by MoPHP for NCDs prevention and control.

Table 2: List of some policies and activities for NCDs prevention and control

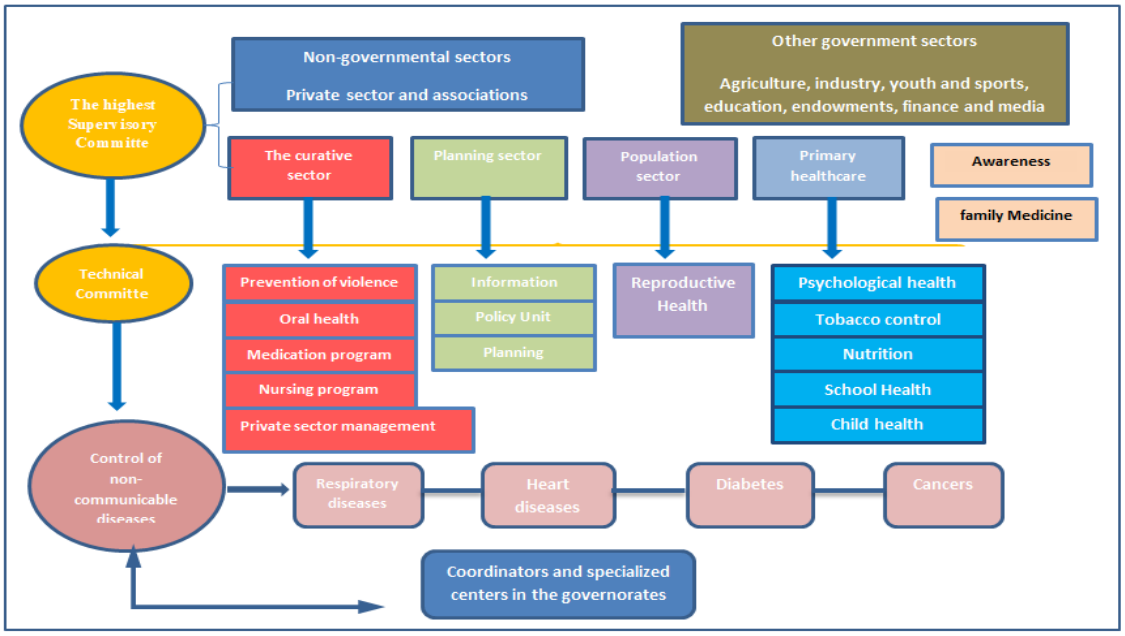
-Signing on WHO Framework Convention on Tobacco Control((WHO FCTC)in 2003	-Yemen Diabetes Association was established in 2003.
-Prime Minister's Resolution No. 379 of 2013 Issuing the Executive Regulations of the Law No. 26 of 2005 Concerning Combating Smoking and Treatment of its Damages	-GCC Standardization Organization (GSO) 246/2011 on Labeling of Tobacco Product Packages
-Establishment of National Tobacco Control Programm in2007	-Joint Statement for the Ministers' of Health for the Cooperation Council States on Diabetes
-Development of National Strategy and Action Plan for tobacco control in 2009	-Gulf charter of Health of the Heart: Putting Heart First
-Enactment a complete ban on all tobacco advertising, promotion and sponsorship in 2013	-Rheumatic heart diseases control and prevention policies
-GCC Standardization Organization (GSO) 246/2011 on Labeling of Tobacco Product Packages	-Resolution of the Prime Minister No. 126 Concerning the Protection of Society and Individuals from the Hazards of Smoking
-Developing a Cancer Control Action Plan in 2008	-Adaptation and translation of the "Global Strategy on Diet, Physical Activity and Health"
-Establishment of 5 Cancer Registry Centers	

Source :Author's summary based on WHO and NHSP 2010-2025(48)(181).

In 2014, the MoPHP organized a national program to combat NCDs, following advocacy from the WHO(49). **Figure 8** shows the proposed structure for NCDs program, which focused on the 4NCDs and the role of all stakeholders for NCDs prevention and control. The merit of this program is the involvement of different stakeholders, including the

private sector, NGOs, and other government sectors. But this also requires effective coordination by the MoHPP, which has been weak. The program is lacking proper organization evidenced by the absence of budget planning, support, human resources and infrastructure investment for the program. A technical report suggested that the program is considered as a mere response to increase the promotion for the tackling of NCDs globally as well as at regional level(49).

Figure 8: The proposed structure for NCDs Program in the MoPHP



Source: Workshop report, WHO Yemen, 2014(78).

The national agencies and entities like academic institutions, local NGOs and some private sector players such as pharmaceutical companies, has supported MoPHP directly or indirectly in tackling NDCs. The support has the form of training of health workers, health promotion, coordination and policy development(48)(49).

In light of long term political instability and war, enforcement of laws that related to NCDs RFs, became weaker(52)(49). The capacity of the health sector to coordinate and work experience with other sectors deteriorated with time and unsecure political events. The implementation of laws has been reported to be very weak(49). There were some efforts to ban smoking and introduced some rules such as fines. This was a temporary initiative and vanished very shortly(49).

In 2016, the Minimum Service Package (MSP) that updated from the country's Essential service package (ESP) was developed as health delivery strategy. This was undertaken by WHO with cooperation of MoPHP and other local authorities to support the provision of PHC services at the district level. To facilitate the access and availability of healthcare services including preventive and curative NCDs services during the emergency setting(183) **(see list of NCDs services in MSP, annex 3)**. This strategy has been implemented in 135 out of 333 total districts (184),more details in **chapter 4.**

The lack of NCDs strategic framework, poor implementing of policies; in addition to an inadequate response to health needs will increase the burden of NCDs among citizens.

3.2.2.2 Health system financing

Poor health care financing, remains a growing serious challenge of the health system in Yemen. There is a continuing annual reduction in spending to health from the GDP and based on the latest NHA, in 2015 was 3.3% compared to 4.4% in 2010(54). The Total Health Expenditure (THE) per capita also decreased from USD$80 in 2014 to USD$75.3 in 2015(185). The allocation of funds is highly centralized, and has been traditionally directed disproportionately to hospitals and to urban areas. While the decentralization initiative of 2000 has been reformed to ensure equitable allocation of resources at the district level, one effect of this decision was to increase opportunities for misallocation of resources(47) (53). During the past decade, infrastructure and medical equipment was overfunded (particularly before the conflict), and operations and maintenance have generally been underfunded. Out of the 64 billion YR spent on health in 2013 by the government, only a little was spent on maintenance and operations, resulting in poor supply and underutilization of the under staffed specifically in the peripheral facilities. And allocation for medical supplies and materials constituted only 3%(47).

The main funding for tackling NCDs is the government budget. Besides that MoPHP are receiving financial and technical support from international organizations such the WHO, and other agencies(49). Health insurance is not established yet in the country(49). The government's attempt at earmarking taxes, such as that from tobacco, has not been successful and a clear example is the tax on cigarettes, which was aborted in parliament due to strong opposition lobbying of cigarette merchandisers and manufacturers(47). The government also spends much more on treatment and much less on health promotion and prevention. Surveillance, monitoring and evaluation receives trivial amount of funding and in most cases comes from the support of development partners such as the WHO(49). The huge problem is the high out of pocket (OOP) expenditures which reached 81% of the total THE(54). This leads to catastrophic expenditure and worsening health consequences with economic and psychosocial impacts among the population(63). Major discrepancies also continues to increase between those in rural and urban areas and among poor, IDPs and most vulnerable groups like women, elderly and children. These challenges of the financing health system obstacle the NCDs tackling, therefore increasing burden of NCDs in the country.

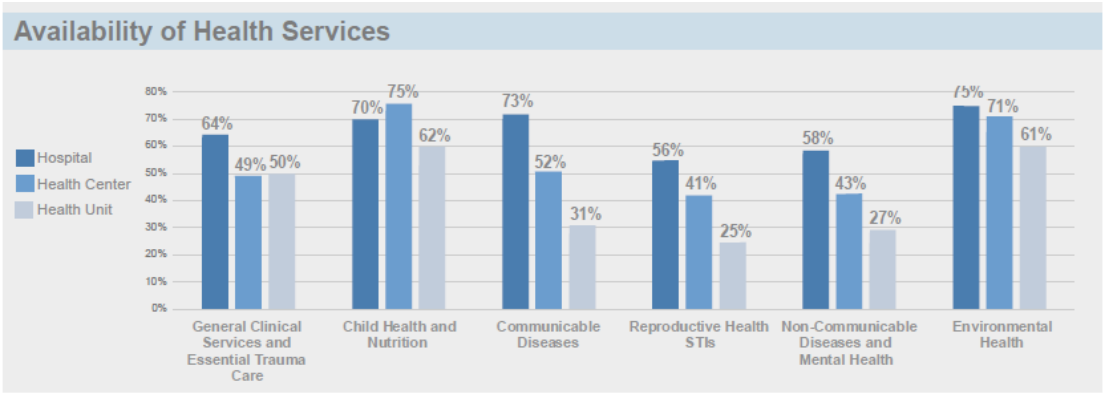
3.2.2.3 Access to and utilization of health care

It is recommended by the WHO NCDs Action Plan that countries should "incorporate evidence-based, cost-effective primary and secondary prevention interventions into the health system with emphasis on primary health care" (186) .In Yemen, providing primary prevention and health promotion, RFs detection and NCDs management in PHC system is not well structured. Likewise the support for self-help and self-care and home-based care in their PHC system is almost absent(49). As highlighted in the background, NCDs services are mostly provided at secondary and tertiary levels and they are costly. While they are absent in most PHC facilities, especially in rural areas, where 62% of the population live(49)(52). This problem causes discrepancies health services coverage for the population. Data from a report in 2014 showed that only 24% of the people in rural areas and 42% of people in all areas, had access to government facilities(49). Lack of access, due to limited geographic coverage, is compounded to some extent, by lack of

access due to need for cash payments required to receive care and drugs. Also indirect costs of transportation to facilities, especially long distances are added to the direct costs(187)(188).

The humanitarian emergency, due to the ongoing conflict, has worsened the already fragmented health system. It causes the suffering of around 19.7 m people with lack of access to adequate health services as a result of a deteriorated public sector. While the private sector exists and remains delivering some services, which are out of reach for millions of vulnerable people, due to their high cost (29). Most of the health services are of low quality with less skilled workers and poor infrastructure, even prior to the started conflict (189). Based on HeRAM data of 2018, from 16 governorates in Yemen, currently only 50%(4966) of HFs are fully functional and 10 health workers(HWs) are available per 10,000 people, which is below the WHO's minimum benchmark (≥22 HWs per 10K people) and this is available just in 3 out 22 governorates(190) .**Figure 9** shows that only 27% of NCDs services are provided at the level of health units, while hospitals have 58% of NCDs services(190).

Figure 9: Availability of Health services in health facilities



Source: Report of HeRAM of 2018(190)

With high rates of poverty in Yemen; the financial burden and barriers are expected to be the major reason for delay, in seeking health care services in particular for NCDs. People cannot afford the high cost of specialized services and in particular when medical consultations of highly qualified clinicians are required(187)(188). The high cost of medications and the long term use of such expensive medicines, like insulin, places another financial burden and fewer medication adherences(191). The OOP payments are very high, reaching more than 81% of Current Health Expenditure (CHE) ,and out of this more than 50% are for medication(192).

There is a lack of standards of care, treatment protocols, basic regulations (and their enforcement) and poor maintenance of facilities and equipment(49). There is a persistent inadequacy of needed supplies and equipment, even where there is adequate staffing(29). These factors are compounded by insufficient supervision, poor management practices, a lack of planning, and referral system(49) . All of these factors lead to underutilization of healthcare services, and to poor health outcomes, including NCDs among the population, intended to be served by those facilities.

Chapter 4: Best and evidence-based practices and interventions

Integrating NCDs services into primary health care(PHC):

The features of the PHC system, including decentralization and integration of care, makes it generally considered as a platform for tackling NCDs (193)(194)(148). In Yemen, the WHO has supported the PHC delivery in collaberation with MoPHP ,through development the Mininmum Service Package (MSP), for the urgent met health needs of people in the crisis setting in 2016 (183). The selected interventions in this package are made on basis of people's health needs, their effectiveness and cost effectiveness, as well as to health system capacity to deliver the services, evidenced from data via Health Resources Availability Mapping System (HeRAMS)(183)(55). This package consists of several servicers covering the maternal, child, nutritional health, NCDs and others. NCDs interventions list are the same as WHO PEN[3] interventions and along with Total cardio-vascular Risk Assessment. Including, CVDs, DM, Respiratory Tract Infections, Arthritis, Skin Diseases and others. In addition to continuing provision of drugs and care management to patients already diagnosed and in treatment. Findings from reports in 2018 from MSP-supported district hospitals, revealed a rise in the utilization of outpatient department (OPD) services by 1.4 fold, compared to 2017. Increasing rates of community-based management of acute malnutrition (CMAM), Reproductive health care (RHC), the expanded program on immunization (EPI) services and other (195).

Community-Based Health Interventions (CBHI)

Studies revealed that community-based approaches provide significant impact, not only because they are cost-effective(196)(197), but particularly because these interventions establish community ownership and sustainability(198). Community health disclosed a successful history of task shifting care's delivery out of facilities. Large-scale CHW interventions have proven the role of mobilizing community mobilization, in extending the delivery of preventive and curative services—particularly for maternal and child health—by filling health gaps not met by facilities alone(199). Community outreach programs have also been expanded to include NCDs, with evidence that CHWs can address broader health's social determinants including; behavioural factors, accurate assessment, cardiovascular risk management, HTN onset reduction, through; behaviour change messages, HTN/ DM control improvement, health screenings conducting, referrals provision to health facilities, patients monitoring, health outcomes tracking, in addition to mitigate the fragility of the health system on services provision. Evidence from Iran, South Africa Pakistan and Haiti shows effective roles of trained CHW in screening, identification of people at high risk of CVD, HTN and DM control in PHC settings (200)(201)(202)(203).

The Isfahan Healthy Heart Program is a lifestyle intervention program from Iran, which demonstrated the effectiveness of such programs in the developing country. In this

[3] "The WHO Package of Essential Non-communicable Disease Interventions (WHO PEN) for primary care in low-resource settings is an innovative and action-oriented set of cost-effective interventions that can be delivered to an acceptable quality of care, even in resource-poor settings. These tools will enable early detection and management of cardiovascular diseases, diabetes, chronic respiratory diseases and cancer to prevent life threatening complications (e.g. heart attacks, stroke, kidney failure, amputations, blindness)"(221) .

project, the intervention was channelled through 10 distinct projects targeting work fields, NGOs and target populations, like women, children, health professionals and high-risk groups. Key intervention strategies include public education through mass media, community participation and education, legislation and policy development. Significant changes were observed in dietary habits (204).

Multi-sectoral national collaboration

The importance of multi-sector approach is recognized as a sustainable strategy to combat NCDs(205). Addressing NCDs RFs encompasses a multi-sectoral, population-wide response outside the health domain. This approach requires partnerships within the health sector and other government sectors. The community is considered as an important partner for involving and delivering interventions(206). For instance, an effective implementation of tobacco control policy in the country requires engagement of multiple government ministries such as Commerce, Finance, Healthcare sector and Media. Countries like Iran, Egypt, Jordan and India have implemented multi-sectoral tobacco control with good scoring in MPOWER measures for tobacco control(207). Additionally, the reduction of population-wide salt consumption by only 15 % (intake of less than 5mg of sodium per day) with collaboration of mass media campaigns and reformulation of foods by industry, is estimated to avert 8.5 m deaths over 10 years in the LMIC with high-burden countries(208).

Surveillance system:

Investment in the surveillance system and its integration into the national HIS is cost effective(209). The Surveillance system will provide data about trends and measurements of RFs exposure, health outcomes, and health system capacity and response. It will provide better information and subsequently better opportunities for improving people's health. By using comprehensive, reliable health data, the government and humanitarian agencies can formulate policies and programs to prevent disease and monitor and evaluate its impact and effectiveness(210) (211). Iran has a good experience in implementing this system, based on the WHO's STEP wise approach. Establishing this system helps Iran in reduction of HTN prevalence and healthy diet consumption among its citizens(212). Evidence from India showed that involving the private primary health providers, who play an important role in NCDs care and in NCDs surveillance, has been enabled in routine reporting (213).

Taxation and legislation

According to the WHO, the cost effective 'best buy' interventions for major RFs of NCDs include; raising taxes on tobacco, raising the purchasing age of tobacco, protecting people from tobacco smoke, warning about the dangers of tobacco, enforcing bans on tobacco advertising, taxing unhealthy substances, and mandating that school and public congregation places be 100% free from smoke. For an unhealthy diet and physical inactivity, reduced salt intake in food, to replace trans-fat with polyunsaturated fat and promote public awareness about diet and physical activity via mass media (209) (214). The national level taxes and legislation are the best buy for creating an environment that protects adults from harmful behaviour and increases the fiscal space from the tax revenues, thus funds for NCDs control. Their effectiveness is constrained by weak regulatory capacity in many countries, emphasizing the importance of supporting governments to improve public outreach, coordination among responsible agencies, like

tax authorities, police and enforcement of laws and regulations(215). Iran, Egypt, Pakistan and Sudan have implemented this intervention with good benefits, in terms of reducing the tobacco use and tax revenues for health(212). Regarding khat and its health problems, Ethiopia imposed some restrictions. The Government has instituted bans on "khat houses" and on chewing khat in the universities and workplaces .And it imposed excise taxes on khat in order to reduce domestic consumption, while boosting export earnings (216).

Chapter 5: Discussion

This study aimed to review and analyze the burden and the determinants of CVDs and DM among the adult population in Yemen. It aimed to review evidence-based interventions from Yemen and other similar settings for NCD prevention and control. The aim was to provide recommendations for implementing effective interventions to reduce NCDs related harmful behaviours and control to the NCDs in Yemen.

This study found that there is a scarcity of reliable data and information related to the burden of NCDs (CVDs, DM) and their RFs, at the national level. The findings do not reflect the current overall picture of CVDs and DM in Yemen. Without clear and accurate information, the actions and work of the MoPHP and its humanitarian partners will remain to muddle through the challenges and sometimes be going through the same vicious circle. There is also a need to depoliticize vital information about the health sector and share/exchange information between the two MoPHP, or between the MoPH and NGOs (local and international). Involvement of the private health providers, who play a vital role in the current situation in service delivery, which will help in improving the availability of data, as seen in the India case. Building the surveillance system and its integration into the national HIS, is critically crucial for a better understanding of diseases burden and their RFs in the context. Also, to assess the capacity of the health system towards tackling this issue. This will help in policy development and implementing effective interventions by MoPHP and other actors to meet the needs of preventive and curative NCDs services.

There are many influencing determinants on the risk of CVDs and DM among Yemeni adults. The modifiable factors, such as tobacco use (smoking and water-pipe), khat chewing, are among the most significant drivers behind the NCDs problem in Yemen. There are limited studies that show the prevalence and distribution of some of those factors and their contributions to NCDs in Yemen. Nevertheless, the relevant information is found in studies from other Arab countries, Afghanistan and Somaliland which show that they significantly contributed to the NCDs burden and their continuous rise (156)(157)(206). The prevalence of smoking of Yemenis adults is one of the highest in EMR. This could be related to many reasons, including the cultural acceptability of smoking among men, concurrent practicing of cigarette smoking with khat sessions, low SES and education. The effect of the war in increasing these risky behaviours and may be related to a high level of stress, which results from rising unemployment rates, poverty, and loss of their homes, jobs and relatives dying due to haphazardly bombings. The high prevalence of waterpipe users among females and adolescents is also considered a serious problem in Yemen and will contribute to the NCDs burden in the future. This indicates to take urgent action through coordinated multi-sectoral interventions.

There is an issue related to incorporating the NCDs policy into the national health policy agenda. This highlights one of the weaknesses of the health system governance even before the conflict. The weakness is the poorly organized national NCDs program. This program lacked financial support, human resources, infrastructure and coordination between MoPHP and other actors for its implementation. Enforcement and regulation of NCDs related policies and laws were not effectively managed. Due to opposition of the implementation of these policies. As the tobacco merchandisers and manufacturers would lose if there are taxes on Khat or more regulations to products that lead to NCDs.

Challenges to implement policies and plans can come from outside the government but also from within the government itself (Curative sector)as this may conflict with their interest .

The presence of two MoPHP with a lack of coordination, leads to the deteriorating of the health system oversight and its capacity to properly respond to health problems in the current conflict. The international stakeholders also work and manage their budget based on their priorities in the emergency response. All of these decrease the required response to health needs, therefore increases the burden of NCDs among citizens.

Multi-sectoral approach is essential to addressing the RFs related to NCDs. Experiences from other countries showed that this approach gives opportunities, including scaling up of health promotion interventions, raising tax revenues to health, and community 's engagement and response to public health laws, thus improving health outcomes. These opportunities are missed In Yemen due to the weak ministry leadership, the governments limited power and lack of the institutional capacity to support implementing multi-sectoral approach to combat NCDs .

NCDs services are mostly provided at the secondary and tertiary levels of the healthcare system in Yemen. This hinders the accessibility of the service. Hence, lower utilization especially among poor and rural dwellers. There is a need for integration of NCDs services into the PHC level and expansion service coverage. This study found that scaling up the Minimum Servive Package, (MSP) which has already been implemented by the WHO in cooperation with MoPHP in some districts, could be the best intervention to support the provision of PHCs services at national level. This will ensure the progress of health service coverage and financial protection of the majority of the population, especially the most vulnerable people.In addition to long term effect in health system strengthening (HSS) and transition to the normal state. Studies in Afghanistan showed that upgrading the Basic package of health services (BPHS) has been shown to significant increase access and utilization of PHC services in the country, especially in rural areas and by disadvantaged groups like women. Besides, it has improved the performance of HIS and the ministry stewardship role, monitoring, transparency, accountability, and significant coordination among all national service providers and international partners. Thus eliminating the duplication in services provision and enhance public-private partnerships (159).

Some challenges may face the country to implement this intervention, due to lack of data ,current governance weakness , lack of technical, operational, financial resources and refusal of some actors, due to their preference of more comprehensive services. This could be addressed via increasing the building capacity of health system (in terms of institutional capacity, training of staff, employment, and implementing task-shifting strategies) through channelling the humanitarian fund for supporting this intervention. Also out contracting the private sector and NGOs with continuous monitoring and evaluating the contextual changes in health need priorities and corresponding required services, cost-effectiveness , and universal health indicators. Also involvement the local authorities and the decision-makers in designing and planning of future scaling up this package.

Study limitations and strengths: To our knowledge this is the first study to review and analyse the burden and determinants of both CVDs and DM after the conflict, and gives an overall situational analysis for CVDs and DM in Yemen. However it has some

limitations: First, due to the ongoing conflict, there is no up to date population-based data or information, except for some estimated data or reports by international NGOs. Data from the latest NDHS of 2013 or the HIS department in the MoPHP is limited and incomplete. Secondly, this study relied mostly on online data and reports that have many gaps. Some data was weak in quality and with limited geographical coverage. Thirdly, age disaggregation of some data is overlapping with young age groups, so there may be overestimation or underestimation. Fourth, there might be a bias ascends from a non-accurate translation of the Arabic literature, according to the author's understanding. Lastly, the required word count limits the thesis.

Chapter 6: Conclusion and Recommendation

6.1 Conclusion

The study found that the burden of NCDs (in particular CVDs and DM) is a serious public health issue, in terms of premature mortality among the adult population in Yemen. Many determinants are influencing CVDs and DM development. The major determinants are the modifiable factors such as behavioural factors represented by tobacco use, khat chewing and the consumption of an unhealthy diet. Those factors interconnect with other determinants like cultural, economic, low level of education and conflict consequences. The NCDs burden in Yemen is also affected by the endless challenges of the health system, which was already fragmented before the war and has worsened due to the current conflict. Health System Fragmentation adversely affects the NCDs tackling at different dimensions: information and data of NCDs are not integrated into the national HIS; the lack of integrated NDCs prevention and control services into the PHC services. Additionally, weak governance and coordination with other government sectors are dominant in the health/public sector. Although some activities have been made for the prevention and control of NCDs in Yemen, yet much more effort is highly required.

6.2 Recommendations

The following suggested recommendations are based on the findings of the study:

1- To support the information system to include NCDs surveillance and its integration into the national HIS. Sharing information between all stakeholders working in health to develop effective interventions.
2- To develop a strategic framework to address NCDs. This will require the curative sector to conduct a strategic audit for its capacity and to identify weaknesses and strengths.

3- To strengthen the coordination with the humanitarian agencies and define the roles and coordination to avoid parallel structures that take over the role of the MoPHP.
4- To conduct further qualitative and quantitative researches to generate more information about the current burden of NCDs and socioeconomic, political consequences of chronic NCDs.
5- To increase political, financial, and technical commitments to the prevention and control efforts in order to respond to the double burden of infectious and chronic NCDs.
6- MoPHP should collaborate with other sectors to enhance policies and action plans to counter NCDs and reduce their risk factors in the community to:
    a. Support health education and promotion through public media like television and radio stations.
    b. Encourage civilian societies to use social media for awareness messages related to healthy behaviours.
    c. Establish school and non-school clubs and workshops to raise awareness for behavioural change at health education centres.
    d. Advocate for laws that ban youth to buy and sell tobacco and Khat.
    e. Enforce tobacco industries to put warning messages on packaging and for food industries to adapt healthy food productions

f. Strengthen the capacity of people to make healthier adoptions and follow lifestyle patterns like subsidizing fruits and vegetables, instituting public sports areas with sports equipment.

7- To strengthen the health systems, especially PHC system, through the integration of NCDs prevention and control activities

8- To scale up MSP with building capacity of health system at the national level to reduce fragmentation at service delivery and ensuring equitable access to health services, especially for those who are poor and in rural areas.

9- To Strengthen the CHI programs and training the CHWs and community volunteers (CVs).

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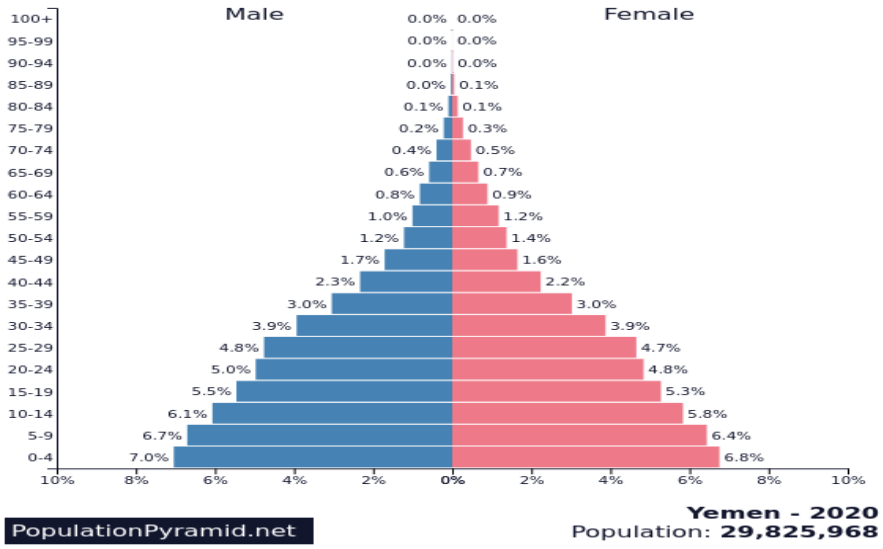
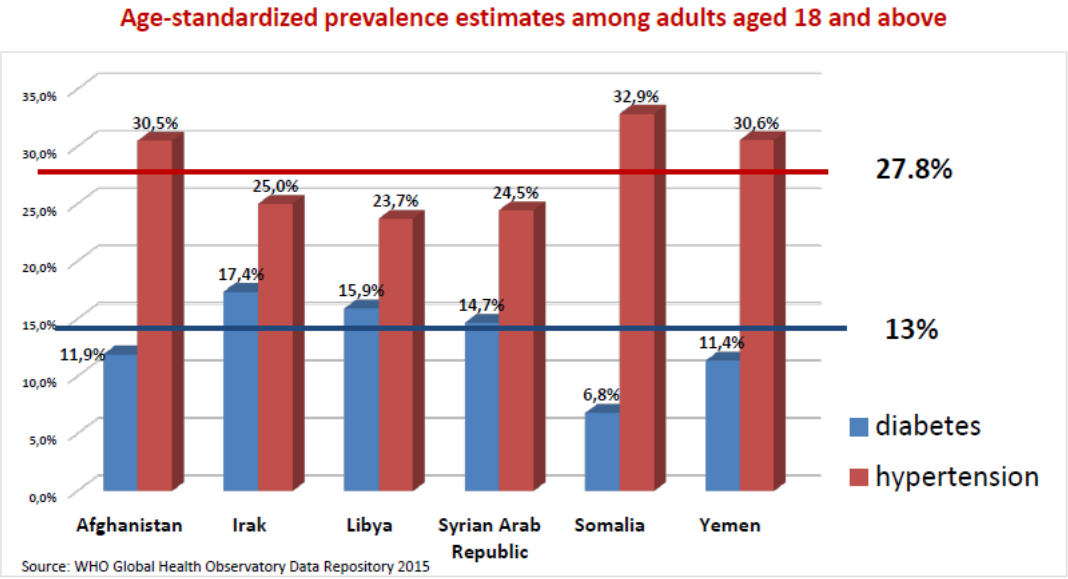
Annexes

Annex 1: Yemen Population Pyramid



Source: Population Pyramid .net (217).

Annex 2: Prevalence of hypertension and diabetes in EMR emergency countries



Source: WHO Global Health Observatory Data Repository,2015(218).

Annex 3: List of NCDs services in MSP.

Healthcare level	Priority list of NCDs and mental health interventions	Facility /Service Provision
PHC	-Asthma and chronic obstructive pulmonary disease (COPD): classification, treatment and follow-up, availability of drugs -Hypertension: early detection, management and counseling (including dietary advice), follow-up, with the availability of functioning blood pressure apparatus, and drugs as per national protocols -Diabetes: early detection, management and monitoring (availability of blood glucose and urine ketones test strips, oral anti-diabetic), counseling (including dietary advice), foot care, follow-up, insulin available only at Hospital level -Oral health and dental care (outside MSP but present in many facilities) -Psychological first aid for distressed people, survivors of assault, abuse, neglect, domestic violence, and linking vulnerable individuals/families with resources, such as health services, livelihood assistance, etc. -Management of mental disorders by specialized and/or trained and supervised non- specialized health-care providers, availability of fluoxetine, carbamazepine, haloperidol, biperiden, and diazepam	Health Unit PHC Centre
Secondary and Tertiary levels	-Rehabilitation services and assistive device provision, including post-operative rehabilitation for trauma-related injuries -Inpatient care for the management of mental disorders by specialized and/or trained and supervised non-specialized health-care providers	District HospitalInter - District Hospital and Governorate Hospital
Community-level	Promote self-care, provide basic health care and psychosocial support, identify and refer severe cases for treatment, provide needed follow-up to people discharged by facility-based health and social services for people with chronic health conditions, disabilities, and mental health problems	Community Home (CMF, CHV) Community (CHW, CHV) Mobile Team facility

Source : WHO, MoPHP (183)