

# Chapter 12

## Epidemiology of Noncommunicable Diseases



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### Key Points

- The growing burden of non-communicable diseases (NCDs) is one of the major public health challenges facing all countries in the twenty-first century.
- The common risk factor for NCDs are tobacco use, alcohol use, unhealthy diet, physical inactivity, raised blood pressure, overweight/obesity, etc.
- Prevention of NCDs should integrate the strategies of individual-based high-risk population and population-based all-population.

## 12.1 Introduction

### 12.1.1 Definition

Noncommunicable diseases (NCDs) are the diseases characterized by multifactorial causation, long latent period, indefinite onset, and noncontagious among individuals. NCDs include broad types of diseases such as cardiovascular disease, renal disease, nervous and mental disease, musculoskeletal conditions, chronic non-specific respiratory disease, cancer, diabetes, and various other metabolic and degenerative diseases. In this chapter, we focus on cardiovascular disease, cancer, and diabetes. The risk factors of NCDs generally include tobacco use, alcohol use, physical inactivity, unhealthy diet, and some unhealthy conditions such as overweight/obesity, high systolic blood pressure, high fasting plasma glucose, and high cholesterol levels.

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## ***12.1.2 The Influence of NCDs on Health and Society***

At the broadest level of the global burden of disease (GBD) hierarchy, NCDs contributed 73.4% or 41.1 million deaths. At Level 2, the largest numbers of deaths from NCDs were 17.8 million deaths for cardiovascular diseases, 9.56 million deaths for neoplasms, and 3.91 million deaths for chronic respiratory diseases. Total disability-adjusted life years (DALY) from NCDs increased by 36.6% from 1.07 billion in 1990 to 1.47 billion in 2016. In China, NCDs are also leading cause of deaths and account for 80% of all deaths. For Chinese population in 2017, stroke, ischemic heart disease, chronic obstructive pulmonary disease (COPD), and lung cancer were the leading four causes of all-age DALYs in 2017.

Treatment, rehabilitation, and taking care of disability from chronic diseases have formed tremendous pressure on the individuals, family, society, and health system. The economic burden of NCDs is huge, involving in not only the huge extra health care spending of personal, family, and society due to chronic disease, but also the loss of productivity due to illness, disability, and premature death.

## **12.2 Epidemiological Features**

### ***12.2.1 Overall Global NCDs Outlook***

For the time distribution of NCDs, deaths from NCDs increased by 22.7% from 33.5 million in 2007 to 41.1 million in 2017 globally, while the death rate decreased by 7.9% from 582.1 deaths per 100,000 in 2007 to 536.1 deaths per 100,000 in 2017. Declines in cardiovascular disease and neoplasms are slowing in many high-income countries. For the place distribution of NCDs, there are significant difference in incidence, mortality from NCDs between low-, middle-, and high-income countries. In low- and middle-income countries, communicable disease and maternal and infant mortality remain at a high level, but deaths from chronic disease are lower than in high-income countries. Due to the large population in all low- and middle-income countries, the absolute numbers of chronic disease patients are still higher than that of those in high-income countries. About three-quarters of chronic disease death, three-quarters of death from cardiovascular disease and diabetes, 90% of chronic respiratory disease deaths, and two-thirds of cancer death overall globally occur in low- and middle-income countries. The age-standardized mortality is not affected by population size and age composition of the population. In 2012, the age-standardized mortality of chronic disease in low-income countries (625/100 thousand) and middle-income countries (673/100 thousand) was higher than that in high-income countries (397/100 thousand).

The trend of incidence and mortality of NCDs between low-, middle- and high-income countries is different. In some high-income countries, mortality of cardiovascular disease and some cancers (e.g., lung cancer) shows a declining trend. For

instance, since the 1950s, the age-standardized mortality of heart disease, stroke, and cancer declined 70%, 78%, and 17%, respectively, in the United States. From 1980 to 2010, compared to the significant reduction of age-standardized mortality of ischemic heart disease in high-income countries, Eastern Europe, Central Asia, South Asia, and East Asia have shown significant upward trends. South Asia has a larger population, and the average death age of ischemic heart disease is younger, and the years of life lost (YLLs) due to premature death is greatest. Since early 1990s, ischemic heart disease became popular in Eastern Europe and Central Asia, the crude mortality and age-standardized mortality in these regions are the highest overall world. In North Africa, the Middle East, and Southeast Asia, the average death age of ischemic heart disease is younger, and the age-standardized mortality is higher, which indicates the death of ischemic heart disease is more likely occur in the labor population.

The early onset of illness is becoming common. Irrespective of gender, persons from all age groups will be affected by chronic diseases. Chronic disease is common in older persons. However, the data from 2012 showed that 42% of NCDs death occurs in the person less than 70 years old (is regarded as premature deaths). The proportion of premature deaths in low- and middle-income countries (48%) is higher than that in high-income countries (28%).

For cardiovascular disease (CVD), most countries experienced four stages: low stage, rising stage, peak stage, and decline stage. Before the 1950s, the social economy, living, and medical conditions were at lower status, infectious disease were the major threat to human health. The incidence of cardiovascular disease was relatively low, and the number of deaths accounted for only from 5% to 10% of total deaths. Industrialization improved social economy and living condition, which result in increased nutrition, diet high in sodium, and insufficient physical activity. The incidence of CVD in the population was rising, and the death due to CVD accounted for 10–30% of total death (Stage II). High-fat, high-protein, high-calorie diets and inactive physical activity led to a rapid increase in CVD, especially coronary heart disease (CHD) and ischemic stroke. The incidence and death appeared a younger trend, and the death accounted for 35–65% of total death (Stage III). Due to public health measures such as health education and community intervention and progress in medicine, the incidence and mortality of CVD declined gradually and the composition of death reduced to less than 40% (Stage IV). Most countries and regions followed the above four stages in CVD epidemic, but different countries enter different development period, and the current stage is different. For example, Western Europe, North America, Australia, Japan, and Korea due to high degree of industrialization, CVD currently entered Stage IV. While Eastern Europe, Russia, the Middle East, and some fast-growing countries, the mortality of CVD has increased 50–100% which accounts for 40–60% of total death within recent 30 years. In Asia, Latin America, and Africa, CVD begins to enter Stage II and the composition of death accounts for under 30% of total death.

For cancer, from a global perspective, the incidence and mortality of cancer are increasing gradually, except for cervical cancer, esophageal cancer, and stomach cancer. The epidemiological feature of cancer among countries and regions is

different. Lung cancer has a higher age-standardized incidence in North America, the middle region of Western Europe, South Europe, North Europe, and East Asia, but lowest in the Middle and West Africa. Breast cancer in developed countries (except Japan) has higher incidence with 89.7 per 100,000 in Western Europe, but lower incidence in most underdeveloped countries with less than 40 per 100,000. Generally speaking, high incidence of cancer in developed countries is lung cancer, breast cancer, colon cancer, and prostate cancer.

For diabetes mellitus, the incidence between types, countries, and races are different. For type 1 diabetes mellitus, the difference in age-adjusted incidence is 350 times at the global level. Sardinia of Italy (36.8 per 100,000) and Finland (36.5 per 100,000) own the highest incidence, other European and American countries have middle incidence (from 5.0 per 100,000 to 19 per 100,000), and the lowest incidence (from 0.1 per 100,000 to 5.0 per 100,000) happens in some Asia countries (such as China, Japan, and Korea), American Indians, Mexicans, Chileans, and Peruvians. Type 1 diabetes show the increased incidence with far away from the equator. For type 2 diabetes mellitus (T2DM), the incidence is related to lifestyle. Keeping traditional way of life shows lower incidence, while some westernized developing countries show higher incidence. The prevalence of type 2 diabetes in rural Africa in adults is from 1% to 2%; however, in North America and Western Pacific Region, about from 1/3 to 1/2 of adults have been diagnosed as type 2 diabetes.

### ***12.2.2 Epidemiological Features of the Risk Factors of NCDs***

It is accepted that a set of “risk factors” are responsible for morbidity and premature mortality of NCDs. A large percentage of NCDs are preventable through the changes in these factors, which include tobacco use, physical inactivity, alcohol use, unhealthy diet, raised blood pressure, overweight/obesity, high cholesterol, cancer-associated infections, and environmental risk factors.

#### **12.2.2.1 Tobacco Use**

The number of men smokers has steadily increased in the first half of the twentieth century and up to a peak of 80% within several decades after World War II. The rate of smoking among men began to decline in English-speaking countries and North European countries, but female smokers began to ascend in these countries at first and after the last half of the twentieth century, then spread to Japan, Latin America, central Europe, and south Europe.

In 2012, the smoking prevalence was 22% and had obvious regional difference. The smoking prevalence is highest in European countries (30%) and is lowest in Africa (12%). The smoking prevalence among male (37%) is higher than that among female (7%). In 2010, the incidence of smoking among adult was 28.1% (male

52.9% and female 2.4%). Among men, the highest smoking age is 45–64 years old (63.0%) and the lowest is 14–24 years old. Smokers in rural areas accounted for 56.1% higher than those in urban region (49.2%). Prevalence of second-hand smoking is up to 72.4%.

#### **12.2.2.2 Alcohol Use**

Alcohol use is undoubtedly a risk factor for NVDs. It is reported that the harmful use of alcohol is one of the four behavioral risk factors (tobacco use, unhealthy diet, physical inactivity, and alcohol use) for three major NCDs (cardiovascular disease, cancer, and chronic respiratory disease). About 2.3 million people die from the harmful use of alcohol each year, contributing about 3.8% of the world's total deaths. The attributable DALYs is high for alcohol (85.0 million DALYs). Adult alcohol consumption is highest in Europe and America and lowest in Mediterranean countries and Southeast Asian countries. The heavy episodic drinking within the past 30 days is highest in Europe and America.

#### **12.2.2.3 Unhealthy Diet**

Unhealthy diet is a key modifiable risk factor for NCDs, which include inadequate consumption of fruits and vegetables, excessive consumption of sugar-sweetened beverages (SSBs), high sodium intake, and high consumption of saturated fats and trans-fatty acids. Evidence showed that inadequate consumption of fruits and vegetables increases the risk of CVD, stomach cancer, and colorectal cancer. High consumption of SSBs was associated with excess energy intake and was strongly linked to obesity. People with much higher levels of sodium input than recommended by WHO are at higher risk for high blood pressure and cardiovascular disease. High intake of saturated fats and trans-fatty acids has been linked to heart disease. Unhealthy diet is increasing rapidly in low-resource areas.

#### **12.2.2.4 Physical Inactivity**

Physical inactivity means the inability to achieve the recommended levels (at least 30 min of regular, moderate-intensity physical activity on most days) of physical activity for health. It is the fourth leading cause of death worldwide and is the major risk factor for NCDs. About 9% of all deaths globally are attributed to physical inactivity. People who lack physical activity have a 20–30% increased risk of all-cause death. Physical inactivity is most severe in high-income countries, but it is significant in some middle-income countries, particularly among women.

### 12.2.2.5 Raised Blood Pressure

It is estimated that raised blood pressure cause 7.5 million deaths, about 12.8% of all deaths. The percentage of populations with raised blood pressure was higher in regions with lower income level. In low-income and middle-income countries, such as eastern, western, middle, and southern Africa and Mongolia in Asia, about 30% of the population had raised blood pressure, but other countries had a lower population of raised blood pressure.

### 12.2.2.6 Overweight/Obesity

Since 1980, prevalence of overweight/obesity has a steady rise with the fastest speed in the United States, with the second fastest is in China, Brazil, and Mexico. In 2014, the prevalence of overweight (BMI (body mass index)  $\geq 25$  kg/m<sup>2</sup>) of adult was 38% and 40% in male and female, and the prevalence of obesity (BMI  $\geq 30$  kg/m<sup>2</sup>) accounts for 11% and 15%. The highest prevalence of overweight/obesity is in the American countries (overweight 61% and obesity 27%), and the lowest is in Southeast Asia (22% and 5%).

## 12.3 Risk Factors of Several Common NCDs

### 12.3.1 *Cardiovascular and Cerebrovascular Disease*

#### 12.3.1.1 Stroke

Stroke, also known as cerebrovascular accident, is an acute cerebrovascular disease, which including ischemic stroke and hemorrhagic stroke. Damage to brain tissue occurs when a blood vessel in the brain suddenly bursts or becomes blocked, then preventing blood from flowing into the brain. Stroke does not occur by chance, and there are factors that occur several years before stroke. The risk factors are as follows:

1. Hypertension

Hypertension is the main risk factor for cerebral thrombosis as well as cerebral hemorrhage. Data from prospective studies showed that the risk of stroke is increased by 49% with each increase of 10 mmHg in systolic pressure, and is increased by 46% with each increase of 5 mmHg of diastolic pressure. The geographic distribution of stroke is consistent with that of hypertension in morbidity and mortality.

2. Heart disease

Heart damage is the second highest risk factor for stroke. In Framingham heart study, the majority of stroke patients had coronary heart disease, congestive heart failure, and atrial fibrillation.

### 3. Diabetes

Diabetes is also an independent risk factor for stroke. The incidence of stroke in individuals with diabetes is 2.5–3.5 times higher than those without diabetes. Men with type 2 diabetes are three times of risk in having a stroke than nondiabetic patients, but women with type 2 diabetes have five times risk than nondiabetic patients.

### 4. Dyslipidemia

The incidence of stroke is increased by 25% for every 1 mmol/L increase in serum total cholesterol. The incidence of ischemic stroke is reduced by 47% for every 1 mmol/L increase in high-density lipoprotein (HDL).

### 5. Other factors

Additional factors include obesity, smoking, glucose intolerance, blood clotting and viscosity, and oral contraceptives.

## 12.3.1.2 Coronary Heart Disease

### 1. Hypertension

The prevention of hypertension and the improvement of blood pressure are essential and fundamental steps for CHD prevention. The famous Framingham heart study showed that prehypertension and Stage 1, Stage 2, and higher hypertension increased the risk of CHD in both men and women. In the past, emphasis was placed on the importance of diastolic blood pressure (DBP). Many investigators feel that systolic blood pressure (SBP) is a better predictor of CHD than diastolic pressure. However, both components are significant risk factors. A meta-analysis showed that the slope of the association between CHD mortality and normal SBP levels was almost constant across each age range throughout the normal SBP values drop to lower than 115 mmHg. Furthermore, for the age-specific hazard ratio between CHD mortality and DBP values drop to lower than 75 mmHg, it was equivalent to that associated with a 20 mmHg difference in normal SBP values.

### 2. Dyslipidemia

It is well known that hyperlipidemia with elevated serum total cholesterol, low-density lipoprotein (LDL) cholesterol, and triglycerides is a major risk factor for CHD. The increased serum total cholesterol and low-density lipoprotein and declined high-density lipoprotein are associated with increased risk of CHD. The risk of CHD is decreased by 2% for every 1% decrease in serum TG. The reduction of every 0.03 mmol/L in HDL-C will increase the risk for CHD by 2–3%. The prevalence of dyslipidemia was 75–85% in patients with early onset CHD, compared with 40–48% in age-matched controls without CHD. Clinical studies have shown that lowering total or LDL cholesterol can play a better role in primary or secondary prevention.

### 3. Diabetes

CHD is common in patients with diabetes, and its prevalence increases with worsening glycemic status due to a higher risk of accelerated atherosclerosis and other lipotoxic and glycotoxic effects. The risk of CHD in people with diabetes is 2–3 times higher than in those without. In industrialized countries, 30–50% of diabetic among people over the age of 40 years die from CHD.

### 4. Overweight/obesity

The overall obesity rate among adults was 12.0% in 2015, with higher rates in women across all age groups. Globally, elevated BMI causes more than four million deaths and 120 million DALYs each year, most of which are directly attributable to the subsequent development of cardiovascular disease. In fact, between 1980 and 2000, higher BMI resulted in approximately 25,905 additional deaths due to CHD. Compared with normal weight, the relative risk for those overweight/obesity developing to CHD and death is 1.5–2.0.

### 5. Tobacco use

Tobacco use has been identified as a major CHD risk factor. Nearly, six million people die each year from tobacco use, including direct smoking and second-hand smoking. Data from several studies suggest that the relative risk of CHD is 2–3 times higher among smokers. These risks have age gradient, with higher relative risk in the younger age group (5–6 times).

### 6. Physical inactivity

A sedentary lifestyle is associated with the risk of early CHD development. There is evidence that regular physical activity reduces body weight and blood pressure and increases the HDL level, which are beneficial for cardiovascular health. In a meta-analysis of 43 prospective cohort studies, compared with 600–3999 MET-min/week of total physical activity across all domains, the RR among people <600 MET-min/week increased by 19%. A total of 5.0% CHD deaths can be attributed to physical inactivity.

## 12.3.2 T2DM

### 12.3.2.1 Genetic Factor

T2DM has strong family aggregation. The prevalence of diabetic relatives is 4–8 times higher than that of nondiabetic relatives. Twin studies have shown a consistency of about 90% in identical twins with T2DM, thus demonstrating a strong genetic component. The heritability of T2DM in China is 51.2–73.8%. In addition, a person's risk of developing diabetes may also depend on the genetic susceptibility to diabetes. Many genome-wide association studies have investigated genetic variants in different populations that influence disease susceptibility through rare alleles and common variants. For example, Chauhan et al. showed the association of eight gene variants (PPAR $\gamma$ , KCNJ11, TCF7L2, SLC30A8, HHEX, CDKN2A, IGF2BP2, and CDKAL1) with diabetes in Asian Indians.



### 12.3.2.2 Overweight/Obesity

Overweight/obesity, particularly central adiposity, has long been accepted as a risk factor for prediabetes or type 2 diabetes (T2DM). Overweight/obesity leads to inflammation, endoplasmic reticulum stress, and fat factor, all of which occur in the pathogenesis of insulin resistance of the liver and skeletal muscle in the work, and increase the risk of diabetes. In a meta-analysis of 84 articles involving more than 2.69 million participants, the combined prediabetes risk of overweight/obesity versus normal weight was 1.24. Based on the race-specific BMI classification, the combined risk for type 2 diabetes relative to normal weight was 0.93 for underweight, 2.24 for overweight, 4.56 for obese, and 22.97 for severely obese. The RR of T2DM in overweight/obesity decreased with age. Another meta-analysis showed that obesity in children and adolescents was positively associated with the prevalence of T2DM and prediabetes, in which obese subjects 13 times higher than normal-weight subjects. The prevalence of prediabetes was three times higher in obese subjects (17.0% vs 6.0%, respectively).

### 12.3.2.3 Physical Inactivity

Sedentary lifestyle is an important risk factor for the development of T2DM. Lack of exercise may alter the interaction between insulin and its receptors, which can lead to T2DM. Those who watched TV for 4 h a day had a 46% higher risk of developing diabetes less than 1 h a day. Meta-analysis of 55 prospective cohort studies <600 MET-min/week versus 600–3999 MET-min/week of total physical activity across all domains: 1.17 (1.11–1.23) 4.5 (3.1–6.0) type 2 diabetes 2.7 (1.9–3.5) 4.2 (2.9–5.7) 5.9 (4.2–7.7).

### 12.3.2.4 Unhealthy Diet

Both food calories and the quality of diet components affect the risk of diabetes. Excessive calorie intake can increase the overweight, with the passage of time, the metabolism of liver glucose control and steady state would be destroyed. Poor dietary quality, such as low intakes of dietary fiber, low-sugar carbohydrates, or whole grain grains, increases the risk of diabetes, as does high intakes of saturated fatty acids and trans fats. A diet containing high-quality fats and carbohydrates rather than low-quality fats and carbohydrates is more important than the relative amounts of these nutrients in preventing type 2 diabetes.

### **12.3.2.5 Malnutrition**

Malnutrition in early infancy and childhood or undernutrition early in life (e.g., exposure to famine) can lead to partial beta cell failure, impaired carbohydrate tolerance, and increases the risk of developing type 2 diabetes later in life.

### **12.3.2.6 Impaired Glucose Tolerance (IGT)**

IGT is an intermediate state between normal and diabetes. The IGT patients have a higher prevalence of diabetes. When IGT patient was followed up to 5–10 years after the first diagnosis, about one-third of the individuals have developed into diabetes, one-third were converted to normal blood glucose and one-third remained IGT status. IGT is easily converted to diabetes when accompanied by the following factors: fasting blood glucose, 2-h blood glucose, and BMI more than 5.0 mmol/L, 9.4 mmol/L, and 25, respectively. Improved diet and increased physical activity are beneficial in reducing the chance of IGT conversion to diabetes.

### **12.3.2.7 Insulin Resistance**

Clinical studies found that insulin resistance occurred in obesity, type 2 diabetes, hyperlipidemia, hypertension, coronary heart disease, stroke, etc. Blood insulin plays a vital role in the process of diabetes development from normal or IGT. Insulin resistance is a common pathophysiological mechanism in above pathological processes.

### **12.3.2.8 Maternal Diabetes**

Offspring of diabetic pregnancies, including gestational diabetes, tend to be large and heavy at birth, tend to develop obesity in childhood, and have a high risk of developing T2DM in early life. The risk of diabetes was three times higher in children born to mothers with diabetes than in children born before their mothers. Maternal diabetes, which is associated with intrauterine growth retardation and low birth weight, appears to increase the risk of later diabetes in children if it is associated with subsequent rapid growth catch-up.

### **12.3.3 Cancer**

#### **12.3.3.1 Physical Factors**

Ionizing radiation (X,  $\gamma$ ,  $\alpha$ ,  $\beta$ -ray, etc.) can cause a variety of human cancer including lung, breast cancer, leukemia, multiple myeloma, thyroid cancer, skin cancer, etc. In occupational factors, other physical factors such as asbestos fiber, coal dust, and quartz dust can result in lung cancer and mesothelioma.

#### **12.3.3.2 Tobacco Use**

Many large prospective studies have provided that tobacco use increases the risk of cancer mortality, especially lung cancer. Tobacco use also leads to larynx, oral, head and neck, pharynx, esophagus, bladder, pancreas, cervical, breast, and probably kidney cancer. A prospective studies reported that the age-adjusted incidence rate of cancer is highest in current smoker, with the RR is up to 12.0 for lung cancer. The attributable risk for oral-bladder cancers, other cancers, and all cancers were 46%, 16%, and 29%, respectively. Another systematic review showed that men who are current smokers have a moderately increased risk of total cancer compared to those never smoked. In women, the risk is increased but less than in men. The overall relative risk was estimated at 1.53.

#### **12.3.3.3 Alcohol Use**

Excessive intake of alcoholic beverages is associated with oral, pharyngeal, esophageal, liver, colon, rectal, and breast cancer. With the exception of the American Cancer Society and the Canadian Cancer Society, all organizations state that alcohol is a class carcinogen and that even small amounts of alcohol can increase the risk of certain cancers. However, some studies showed that light or very light alcohol use was not associated with the risk of common tumors, except for mild increases in breast cancer in women and colorectal cancer in men.

#### **12.3.3.4 Dietary Factors**

A lot of studies suggested the potential role of diet in certain cancers. However, there is no guarantee of cancer prevention. The study of diet and cancer risk reduction is complicated not only by the multistage, multifactor nature of the disease, but also by the inherent complexity of any diet. Prospective cohort findings support an association between unhealthy eating patterns and increased risk of colon and breast cancer, particularly in postmenopausal hormone-receptor negative women. The limited evidence of an association between unhealthy dietary patterns and the risk

of upper digestive tract, pancreatic, ovarian, endometrial, and prostate cancers relies only on case-control studies.

### **12.3.3.5 Occupational Exposures**

Occupational exposure includes exposure to benzene, arsenic, cadmium, chromium, vinyl chloride, and asbestos polycyclic hydrocarbons. The risk of occupational exposure is greatly increased if individuals also smoke. It has been reported that occupational exposures typically account for 1–5% of all human cancers.

### **12.3.3.6 Biological Factors**

Biological factors are one of the main causes of human tumor. By now, it is identified that at least eight viruses have been linked to human tumors. For example, the increased risk of hepatitis B, C virus for hepatocellular, human immunodeficiency virus for Kaposi's sarcoma, the Epstein–Barr virus for Burkitt's lymphoma and nasopharyngeal carcinoma, and human papilloma virus for cervical cancer.

### **12.3.3.7 Genetic Factors**

It is now becoming clear that individual differences in the incidence of tumors are related to genetic background, which means that the occurrence of tumors is also related to the individual's own genetic susceptibility. Although there is probably a complex interrelationship between hereditary susceptibility and environmental carcinogenic stimuli in the causation of a number of cancers. With the completion of the Human Genome Project and the rapid development of high-throughput gene variation detection methods, genome-wide association studies (GWAS) have become a major strategy for revealing tumor susceptibility genes. In recent years, tumor researchers around the world have used GWAS strategy to conduct a series of studies on nasopharyngeal carcinoma, liver cancer, esophageal cancer, lung cancer, pancreatic cancer and other tumors in people around the world, and a large number of genetic variations and genetic loci of tumor-related chromosome regions have been discovered, which is of great significance for fully revealing the causes of tumor occurrence.

### **12.3.3.8 Other Factors**

Other factors include the immune, endocrine, and psychosocial factors. The immune system is closely related to the incidence of cancer. Tumor cells can evade immune system attacks by one or more mechanism or cannot activate specific antitumor immunity and induce the tumor development. Endocrine-related tumors include

breast, ovarian, and testicular cancer. The risk factors for breast cancer include non-procreation, early onset, late menopause, and non-lactation. Social psychological factors are also one of the important risk factors for cancer. Major adverse events and depression can cause psychological stress, which lead to the disturbance of the nervous system and the decline of immunity.

## **12.4 Prevention and Control of NCDs**

### ***12.4.1 Prevention Strategy***

The prevention and control of NCDs emphasize the primordial prevention, which controls the risk factors at the population level. Some of the risks of adult chronic disease begins with adverse exposure in pregnancy. Many unhealthy lifestyles are formed from childhood. Once formed, it is difficult to change. Therefore, the prevention of NCDs takes the life-course approach which is from early life through the whole life period.

Prevention of NCDs should integrate the strategies of individual-based high-risk population and population-based all-population. When the risk factors exist among the whole population, the all-population strategy is particularly important. Smoking ban in public places and workplaces is a successful strategy for the all-population strategy.

Member States in the WHO Western Pacific Region endorsed the “For the Future” Vision at the Regional Committee Meeting in 2019. The paper set out four thematic priorities for making the Western Pacific the healthiest and safest region in the world, one of which is NCDs and aging. The burden of NCDs and related risk factors is a major barrier to the development and achievement of the sustainable development goals (SDGs), the WHO’s Global Action Plan for the Prevention and Control of NCDs 2013–2020 and the “For the Future” Vision. Based on the Global Action Plan for the Prevention and Control of NCDs 2013–2020, WHO provides a list of “Best Buys” and other recommended interventions in 2017 for the four key risk factors for NCDs (tobacco, harmful use of alcohol, unhealthy diet, and physical inactivity) and for four diseases (cardiovascular disease, diabetes, cancer, and chronic respiratory disease) to tackle global NCDs problems.

In order to maintain people’s health and build a healthy China in a well-rounded way, China has recently issued a number of policies, plans, and national actions for the prevention and control of NCDs, which include the National Basic Public Health Service Projects (NBPHSP) to manage hypertension and diabetes in primary health facilities since 2009, community-based and comprehensive intervention projects for NCD, the China Healthy Lifestyle for All (Phases I and II) launched in 2007, the Medium- and Long-Term Plan for the Prevention and Treatment of NCDs (2017–2025), the Outline of the Plan for “Healthy China 2030,” and the Healthy China Action (2019–2030) promulgated by the Chinese State Council. Early in March 2021, China issued the 14th Five-Year Plan (FYP), a high-level development

blueprint for the next 5 years. The 14th FYP calls for “fully implementing the Healthy China Actions,” “strengthening prevention, early screening and comprehensive intervention of chronic diseases,” etc.

### ***12.4.2 Prevention Measures***

There are a variety of measures for the prevention of NCDs. Urgent action is needed to reduce the growing burden of NCDs and prevent the annual toll burden that dying prematurely before the age of 70 from heart and lung disease, stroke, cancer, and diabetes. There is not only a growing awareness and concern about the burden of NCDs on families, individuals, and public health, but also the social and economic burdens associated with the NCDs. Many interventions for prevention and control of NCDs exist. Even in the richest countries, it is essential to choose which interventions to prioritize because resources are limited, and this is especially true in most countries. In 2017, WHO launched Best Buys, which recommended three types of intervention measures, including “the most cost-effective measures,” “effective interventions with cost-effectiveness ratio of more than \$100,” and “other interventions (without cost-effectiveness analysis),” for four chronic behavioral risk factors, tobacco use, unhealthy diet, insufficient physical activity, and harmful use of alcohol.

For tobacco use, the interventions including increased tobacco excise taxes to reduce the affordability of tobacco products, implement plain/standardized packaging and/or large graphic health warnings on all tobacco packages, eliminate second-hand smoke exposure in all indoor workplaces, public places, and public transport, ban cross-border advertising, and offer smoking cessation services to all who want to quit through mobile phone apps. For unhealthy diet, the interventions include reducing salt input, limiting food package sizes and portion sizes, reducing sugar consumption through effective taxes on sugary beverages, and promoting unsaturated fats instead of trans and saturated fats through formulation, labeling, fiscal or agricultural policies, etc.

For physical inactivity, the interventions include reducing physical inactivity, promoting physical activity and national fitness, promoting travel and domestic physical activity, reducing static behavior, providing physical activity counselling and referrals within routine primary health care services using short-term interventions, etc.

For alcohol use, the interventions including increased excise taxes on alcoholic beverages, complete bans or restrictions on alcohol advertising, restrict alcohol use and promote health education, prevention, treatment, and care of alcohol use disorders and their comorbidities, etc.