Non-Communicable Diseases and Their Risk Factors: A Review Article

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Abstract

Background: Non-Communicable Diseases (NCDs) have been proved to be a clear threat to human health together with the development and economic growth. NCDs are the leading cause of death globally, causing over 70% of all deaths. Almost 75% of NCD deaths occur in developing countries and 85% of these deaths are premature (of people aged between 30 and 69 years). This narrative review aims to provide information on NCDs and their risk factors. A systematic search was conducted in PubMed, Embase, Cochrane Library and Web of Science databases, WHO and CDC websites, and grey literature was searched through Google Scholar including scientific literature published from May 2017 until August 2023.

Keywords: Non-Communicable Diseases, chronic diseases, NCDs risk factors, lifestyle behavior.

Introduction

The four main non-communicable diseases are cardiovascular diseases (e.g., coronary heart disease, stroke), cancers, chronic respiratory diseases (e.g., chronic obstructive pulmonary disease and asthma) and diabetes mellitus. These four groups of diseases account for over 80% of all premature NCD deaths **(1).**

A.   **The four main NCDs**

A.1)   Cardiovascular diseases

Cardiovascular diseases (CVD) are a general term used to describe conditions that affect the heart or blood vessels. It is usually associated with atherosclerosis and an increased risk of blood clots. Also, it can be associated with damage to arteries in vital organs such as brain, heart, kidneys, and eyes. CVD can often be prevented largely by maintaining a healthy lifestyle. There are many types of CVD, the four main types are coronary heart disease (angina, myocardial infarction, and heart failure), strokes and transient ischemic attacks (TIAs) or minor strokes, peripheral arterial disease, and aortic diseases **(2).**

Risk factors:

The main individual risk factors are hypertension, tobacco smoking, hyperlipidemia, diabetes, physical inactivity, overweight / obesity, and family history of CVS **(2).**

❖ *hypertension*

a. **Diagnosis:**

The American College of Cardiology / American Heart Association (ACC/AHA) (Table I) guidelines replace "prehypertension" category of the Joint National Committee (JNC) 8 (Table II) classification with

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"elevated blood pressure" for BP levels 120-129/80-89 mm Hg while the European Society of Cardiology / European Society of Hypertension (ESC/ESH) (Table III) defines this category as "normal blood pressure". The American cut-off for diagnosis of hypertension has been lowered to ≥130/80 mm Hg with blood pressure range 130-139/80-89 mm Hg now classified as stage 1 hypertension. However, the ESC/ESH guidelines did not lower the hypertension diagnosis threshold (>140/90 mm Hg), but they do acknowledge that 130-139/80-89 mm Hg is high normal BP. Also, the ESC/ESH guidelines added a third category of hypertension with blood pressure measurements ≥ 180/ ≥ 110 mm Hg **(3).**

Table I: JNC 8 classification of hypertension in adults (age ≥ 18 years) (4)			
Classification	**Systolic blood pressure (mmHg)**		**Diastolic blood pressure (mmHg)**
Normal	< 120	And	< 80
prehypertension	120 - 139	Or	80 - 89
Stage 1 hypertension	140 - 159	Or	90 - 99
Stage 2 hypertension	≥ 160	Or	≥ 100

Table II: ACC/AHA classification of hypertension in adults (age ≥ 18 years) (5)			
Classification	**Systolic blood pressure (mmHg)**		**Diastolic blood pressure (mmHg)**
Normal	< 120	And	< 80
Elevated	120 - 129	And	< 80
Stage 1 hypertension	130 - 139	Or	80 - 89
Stage 2 hypertension	≥ 160	Or	≥ 90
Hypertensive crisis	> 180	And/or	> 120

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Table III: (ESC / ESH) classification of hypertension (age ≥ 16 years) (5)			
Classification	**Systolic (mmHg)**		**Diastolic (mmHg)**
Optimal	< 120	And	< 80
Normal	120 - 129	And / or	80 - 84
High normal	130 - 139	And / or	85 - 89
Grade 1 hypertension	140 - 159	And / or	90 - 99
Grade 2 hypertension	160 - 179	And / or	100 - 109
Grade 3 hypertension	≥ 180	And / or	≥ 110
Isolated systolic hypertension	≥ 140	And	< 90

Diagnosis should be confirmed by serial (at least two) office-based blood pressure measurements **(6).**

b. Complications according to American Heart Association (AHA), 2022 (7):

Uncontrolled elevated blood pressure can lead to many complications including:

• Myocardial infarction or stroke: elevated blood pressure can cause atherosclerosis, which can cause myocardial infarction, or other cardiovascular atherosclerotic complications such as transient ischemic attacks (TIA), stroke, and peripheral arterial disease (PAD).

• Heart failure: longstanding high blood pressure leads to left ventricular hypertrophy. Eventually, this can lead to heart failure.

• Renal dysfunction: Weakened and narrowed blood vessels in kidneys prevents them from functioning normally.

• Hypertensive retinopathy: which can result in blindness.

Metabolic syndrome is a group of disorders of body's metabolism, including increased waist circumference, increased triglycerides, decreased high-density lipoprotein (HDL) cholesterol (the "good" cholesterol), elevated blood pressure, and diabetes. Metabolic syndrome is diagnosed if there are three or more of these conditions **(8).**

❖ *Dyslipidemia*

a. Diagnosis:

Dyslipidemia diagnosis requires lipid profile testing which can be fasting or non-fasting. Non fasting lipid profile is more accessible clinically and simple for both patients and practitioners, whereas the accuracy of the fasting lipid profile depends on patient's compliance. Many guidelines propose that non-fasting Low-Density Lipoprotein- Cholesterol (LDL-C) has similar significance to that of fasting LDL-C. A fasting lipid profile is strongly recommended for patients with type 2 diabetes, obesity, and patients on medications that could affect lipid levels, such as thiazides and beta blockers **(9).**

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Table IV: Lipid profile (10)		
Total Cholesterol (mg/dL)	Below 200	Optimal
	200-239	Borderline high
	≥ 240	High
LDL-C (mg/dL)	< 100	Optimal
	100-129	Near optimal
	130-159	Borderline high
	160-189	High
	≥ 190	Very high.
(HDL-C) (mg/dL) *	< 40	low
	≥ 40	Optimal
	≥ 60	Desirable
Triglycerides (mg/dL)	< 150	Optimal
	150-199	Borderline high
	200-499	High
	≥ 500	Very high

* High-Density Lipoprotein-cholesterol

b. Complications:

Untreated or undertreated hyperlipidemia can cause all types of vascular disease including, but not limited to, coronary artery disease, stroke, peripheral arterial disease, aneurysms, hypertension, type 2 diabetes, and even cardiac arrest **(11).**

❖ *overweight / obesity*

a. Diagnosis:

• **Body mass index (BMI):**

The WHO adopted BMI, which is calculated by dividing the body weight in kilograms (Kg) by the square of the height in meters (m), as a representative measure of total body fat. BMI correlates well with body fat percentage in young and middle age where obesity is more prevalent **(12).**

Table V: Adult BMI classification (12)	
Classification	**BMI (kg/m2)**
Healthy or 'normal' weight	18.5–24.9
Overweight or pre-obesity	25–29.9
Obesity I	30–34.9
Obesity II	35–39.9
Obesity III	$\geqslant 40$

• **Waist circumference (WC):**

Abdominal adiposity is an essential independent risk factor for cardiovascular disease, type 2 diabetes, dyslipidemia, and hypertension even if BMI is within normal limits. Abdominal obesity is considered when WC exceeds 40 inches (102 cm) in males and 35 inches (88 cm) in females **(13).**

b. Complications according to Ansari et al., 2020 (12):

• Mortality: Obesity is associated with increased risk of all-cause mortality. CVD and malignancy are the most common causes of death.

• Impaired glucose tolerance and Diabetes mellitus (DM): most probably due to insulin resistance.

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• Hypertension and CVD: including coronary artery disease and heart failure.

• Dyslipidemia: insulin resistance is associated with increased Very Low-Density Lipoprotein (VLDL) synthesis by the liver and impaired function of lipoprotein lipase.

• Cerebrovascular Disease: Current evidence shows that, in relation to obesity, the risk of hemorrhagic and ischemic stroke is increased in males. While, in females this relation is true with ischemic stroke but not hemorrhagic stroke.

• Respiratory problems: such as bronchial asthma and obstructive sleep apnea (OSA).

• Gastrointestinal problems: such as gastroesophageal reflux disease (GORD), cholelithiasis and non-alcoholic fatty liver disease.

• Urinary problems: such as renal stones and chronic kidney disease.

• Cancer: obesity is the second most important preventable cause of cancer, after smoking, in UK. These include cancer of esophagus (adenocarcinoma), colon, gallbladder, kidney, thyroid, uterus, breast, and leukemia.

• Osteoarthritis: overweight increases the load on the joints as the knee, which in turn increases stress and possibly accelerate the breakdown of cartilage.

• Dementia and Alzheimer's disease: as the cardiovascular risk factors, including type 2 DM, dyslipidemia, and hypertension, which are well-established complications of obesity increase the risk of occurrence of dementia and Alzheimer's disease later in life.

• Psychosocial problems: many obese individuals struggle with issues related to their mood, body image, self-esteem, and quality of life, in addition to stigma, and discrimination. These individuals are more prone to depression, anxiety disorders, and may be substance use. women are more prone to suffer from anxiety and depression than men probably due to society's emphasis on thinness as an important characteristic of female beauty.

A.2)   Cancers

Cancer is one of the leading causes of death globally. In 2018, there were 18.1 million new cases and 9.5 million cancer-related deaths in the world. By 2040, it is expected that the number of new cancer cases per year will rise to 29.5 million and the number of cancer-related deaths to 16.4 million. Cancer rates are high in populations with high life expectancy, education level, and living standard. However, some cancers such as cervical cancer have high incidence rate in populations with low ranks on these measures. The most common cancers are breast cancer, lung and bronchial cancer, prostatic cancer, colon cancer, malignant melanoma of skin, bladder cancer, non-Hodgkin lymphoma, leukemia, kidney and renal pelvis cancer, endometrial cancer, pancreatic cancer, thyroid cancer, and liver cell cancer **(14).**

Risk factors:

Generally, risk factors for cancer include old age, personal or family history of cancer, tobacco smoking, obesity, alcohol, some viral infections, such as human papillomavirus (HPV), and exposure to radiation, including sun ultraviolet radiation and specific chemicals **(15).**

A.3)   Chronic respiratory diseases

Chronic respiratory diseases are chronic diseases of the airways and lung. The most common chronic respiratory diseases are bronchial asthma, chronic obstructive pulmonary disease (COPD), cancer lung, cystic fibrosis, obstructive sleep apnea and occupational lung diseases. Respiratory diseases affect all ages and most of them are chronic in nature and have a major impact on the individual with the disease, family, community, and health care system **(16).**

Risk factors:

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The most important risk factors for chronic respiratory diseases are tobacco smoke (personal smoking and second-hand smoke) and indoor and outdoor air quality. cigarette smoking increases the risk of developing lung cancer, COPD, and asthma. Exposure to second-hand smoke causes cancer in non-smoker adult, sudden infant death syndrome in neonates and worsening symptoms of those with asthma or COPD. **(16)**

A.4)   Diabetes Mellitus

Diabetes is a complex, chronic illness which can be classified into the following general categories: 1. Type 1 diabetes (due to autoimmune destruction of b-cell, usually causing absolute insulin deficiency, including latent autoimmune diabetes of adulthood) 2. Type 2 diabetes (due to a progressive loss of adequate insulin secretion from b-cell often due to insulin resistance) 3. Specific types of diabetes due to other causes, e.g., monogenic diabetes syndromes (such as neonatal diabetes and maturity-onset diabetes of the young), diseases of the exocrine pancreas (such as cystic fibrosis and pancreatitis), and drug- or chemical-induced diabetes (e.g., glucocorticoids, treatment of HIV/AIDS, or after organ transplantation) 4. Gestational diabetes mellitus (diabetes in the second or third trimester of pregnancy which was not overt diabetes before pregnancy) **(17)**.

➢ **Risk factors:**

In both type 1 and type 2 diabetes, multiple different genetic and environmental factors can cause the progressive loss of b-cell mass and/or function which manifests as hyperglycemia. Also, the risk of type 2 diabetes increases with following: advancing in age, obesity, physical inactivity, hypertension, dyslipidemia, strong genetic predisposition, or family history in first-degree relatives (even more than type 1 diabetes), and women with history of gestational diabetes mellitus (GDM) or polycystic ovary syndrome **(17)**.

➢ **Diagnosis:**

Table VI: Diagnostic criteria of diabetes mellites according to ADA, 2022 (17):

	Prediabetes	Diabetes
A1C	5.7–6.4%	≥6.5%
Fasting plasma glucose	100–125 mg/dL	≥126 mg/dL
2-hour plasma glucose during 75-g OGTT	140–199 mg/dL	≥200 mg/dL
Random plasma glucose	-	≥200 mg/dL

In the absence of unequivocal hyperglycemia, diagnosis requires two abnormal test results from the same sample or in two separate samples. Random plasma glucose test is only diagnostic in a patient with hyperglycemic crisis or classic symptoms of hyperglycemia **(17)**.

Classic symptoms of diabetes include thirst more than usual, frequent urination, weight loss despite good appetite, fatigue, Irritability, blurring of vision, Poor wound healing, tingling, and numbness of extremities and frequent infections, such as oral, skin, and vaginal infections **(18)**.

➢ **Complications according to Brutsaert, 2022 (19):**

Long-term diabetes complications develop gradually. Eventually, they may be disabling or even life-threatening. Possible complications include:

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• cardiovascular disease: Diabetes increases the risk of many cardiovascular problems majorly. These include coronary artery disease with angina and myocardial infarction, TIA, stroke, and PAD.

• Cardiomyopathy, and heart failure.

• Neuropathy: High blood sugar can injure the walls of capillaries that nourish the nerves, and directly affect neurons. This can cause symmetric polyneuropathy which affects usually distal extremities (stocking-glove parathesia, hypothesia, and finally anathesia)

Autonomic neuropathy can lead to orthostatic hypotension, tachycardia, gastrointestinal problems such as nausea, vomiting, diarrhea, and/or constipation, urine retention, vaginal dryness in females, and erectile dysfunction in males.

• carpal tunnel syndrome.

• Nephropathy: due to damage of the glomeruli. It usually has no symptoms until nephrotic syndrome, or renal failure develops.

• Retinopathy: diabetic retinopathy could lead to blindness.

• Foot damage: Neuropathy in the feet or poor blood flow increases the risk of multiple foot complications e.g., ulcers, calluses, deformities…etc. which may lead to even gangrene and amputation.

• Skin and mouth conditions: including bacterial and fungal infections as hyperglycemia directly affects cellular immunity leading to immune dysfunction.

• Non-alcoholic fatty liver disease (NAFLD).

**B.	Other NCDs**

NCDs include also, other than the four main NCDs, congenital anomalies (e.g., cleft palate, down syndrome), endocrinal disorders, neuropsychiatric conditions, oral conditions (e.g., dental caries), digestive disorders, genitourinary disorders, skin diseases, and musculoskeletal diseases (e.g., rheumatoid arthritis) **(20).**

Risk factors of NCDs:

So, in conclusion, it can be said that the most important risk factors of NCDs are the following (which are mostly preventable):

❖ *Socioeconomic status*

low socioeconomic status and/or living in developing countries increase the risk of developing cardiovascular diseases (CVD), diabetes, and chronic obstructive pulmonary disease (COPD) **(21).**

❖ *Modifiable behavioral risk factors*

According to WHO, 2021 **(22):**

- **Tobacco** Causes more than 7.2 million deaths every year (including deaths from the effect of second-hand smoke exposure) and is expected to increase over the coming years.

- **high salt intake** has led to about 4.1 million deaths annually.

- **physical inactivity** can be responsible for about 1.6 million deaths annually.

❖ *Metabolic risk factors*

The leading metabolic risk factor globally, of the four key metabolic risk factors, is elevated blood pressure (19% of global deaths) followed by overweight and obesity, and hyperglycemia, in terms of attributable deaths. In addition to dyslipidemia which is one of the important risk factors **(22).**

Conclusion

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Overall, the available data shows that NCDs are the leading cause of death globally, and most of NCD deaths occur in developing countries and majority of these deaths are premature. Data also shows that obese and overweight persons with unhealthy lifestyle behaviors are more prone to different NCDs.

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