International Journal of Current Research and Academic Review

ISSN: 2347-3215 Volume 3 Number 7 (July-2015) pp. 215-223

www.ijcrar.com

Modern Lifestyle Diseases: Chronic Diseases, Awareness and Prevention

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KEYWORDS

Lifestyle Diseases, Chronic Diseases, hypertension, dyslipidemia, Awareness and Prevention

A B S T R A C T

Improved life expectancy by almost 15-20 years in average and reduced infant mortality has been recorded due to unprecedented improvements in public health in recent time. Advances in preventive measurement, medical diagnosis, superior treatment regimes, economic growth and better public policies have been a part of the 21st century industrialisation and urbanization process. The changes in lifestyle and dietary choices greatly increases the risk for non-communicable diseases (NCDs) such as obesity, type 2 diabetes, hypertension, dyslipidemia, sleep-apnea, osteoarthritis, and some types of cancer. Globally almost two thirds deaths (36 million) were because of chronic NCDs. Besides, microbial infection and unhealthy food, sedentary occupational behaviour and inadequate physical activities were another emerging risk factor primarily leading to metabolic disorders. Progressive socioeconomic policies, improved health and social sectors, increased educational opportunities and environment friendly approaches would be the major prevention strategy for NCDs in the near future.

Introduction

Chronic diseases, frequently classified as a major component of non-communicable diseases (NCDs), usually affects the middle or old age individuals after prolong exposure to an unhealthy lifestyle relating mainly to economic transition, rapid urbanization and 21st-century lifestyles: tobacco use, harmful consumption of alcohol, unhealthy 'fast food' diet, insufficient physical activity and extended office working hours. The World Health Organization (WHO) suggested that around 57 million deaths occurred worldwide in the year 2008, of which 36 million deaths – almost two thirds – were because of NCDs, involving mainly cardiovascular diseases, cancers, diabetes and chronic lung diseases (Figure 1) [1]. The leading NCD risk factor globally in terms of attributable deaths are high blood pressure (13%), tobacco use (9%), diabetes (6%), lack of physical activity (6%), and obesity (5%). Nowadays, lifestyle disorders are

becoming more common, affecting younger population especially the young, urban population [1]. Reports suggest that the median age group at risk shifts from fifth decade to perhaps fourth decade of life or even younger persons. A lifestyle with lack of physical activity, often referred as sedentary lifestyle, is one of the leading causes of preventable mortality worldwide. Such type of physiologically-stressed lifestyle results in increased levels of risk factors, like hypertension (high blood pressure), dyslipidemia (abnormal amount of lipids mainly cholesterol or fats in the blood), diabetes (high blood glucose), respiratory diseases, and obesity (abnormal or excessive body fat accumulation) act in parallel and synergistically on the various body metabolic pathways [1-3]. Developing countries are typically burdened lifestyle-related diseases along with other infectious diseases (Figure 1) [4].

In India, the disease profiles and its types are changing quite alarmingly. The WHO has recognized India as one of the nations with maximum number of lifestyle-related disorders in the near future. India is already been considered as the diabetes capital of the world. The most common sedentary lifestyle disorder includes obesity, hypertension, and heart-related diseases. WHO Report suggests that total no. of NCD deaths are 2967600 and 2273800 in males and females respectively [1]. While the percentage of NCD deaths occurring under the age of 70 is 61.8% and 55.0% in males and females, indicating that the younger population is at a higher risk than older peoples[1]. According to a survey done by India's Associated Chamber of Commerce and Industry (ASSOCHAM), 68% working women between the ages of 21-52 years were found to be suffering with lifestyle related disorders such as obesity, depression, chronic backache, diabetes and hypertension [5]. Preventive Healthcare and Corporate Female Workforce study reported that women's with long working hours caused up to 75% of them suffer from psychological disorders such as depression or general anxiety disorder along with other diseases. As per the joint report of the World Health Organization and the World Economic Forum, India will suffer an economic loss of 236.6 billion US dollar by the year 2015 due to unhealthy lifestyles and related disorders. Adding to the qualms, scarcity of epidemiological data on the overall prevalence of chronic diseases in India is also a major health-sector concern. It is mainly due to uncontrolled urbanization and increased level of pollution; secondly because of inadequate access of rural populations to primary healthcare centers; and thirdly due to lack of control and regulation of food quality and contents of adulteration.

In this review we highlighted and discussed the five most common and lethal chronic diseases prevalent globally across different populations.

Cardiovascular diseases

The 1628 publication "*De Motu Cordis" by* William Harvey the circulation and the function of the heart was breakthrough insight for the physiological studies. The 19th-century French physiologist Claude Bernard catheterized animal models to measure the pressures in cardiac chambers. Subsequently in the year 1929, Werner Forssman experimented on himself to become the first human cardiac catheterization followed by André Frédéric Cournand and Dickinson W. Richards to study the cardiac hemodynamics[6]. All three of these investigators- Cournand, Forssman and Richards- for their pioneer scientific discoveries were awarded the Nobel Prize in Physiology or Medicine in 1956. Cardiovascular diseases (CVD),a class

of diseases that involve the heart, the blood vessels (arteries, capillaries, and veins) or both, cause majority of deaths worldwide [4]. Worldwide over 80% of deaths and 85% of disability occur from cardiovascular diseases (CVD) mainly in low- and middle-income countries. Raised blood pressure approximately causes 7.5 million deaths throughout the world. The Indian subcontinent (including SAARC countries-India, Pakistan, Bangladesh, Sri Lanka, and Nepal) caters about 20 percent of the world's population and has become one of the regions with highest burden of CVD cases [7]. The normal systolic and diastolic blood pressure is 140 and 90 mmHg. Abnormal blood pressure levels have been shown to be related to the possibility of stroke(when blood supply to part of our brain is interrupted or severely reduced, thus depriving brain tissue with oxygen and food supply) and coronary heart disease (deposition of fats on the inner wall of the blood vessels, mainly coronary arteries that deliver the heart muscle with blood, clogging the arteries) (Figure 2) [8-9].

Besides coronary heart diseases and stroke, raised blood pressure also causes heart failure, peripheral vascular disease, renal (kidney) impairment, retinal haemorrhage and visual impairment. There is no single reason for coronary heart disease, but several 'risk factors' have been associated that includes: smoking (both active and passive smoking), high blood cholesterol, high blood pressure, diabetes, unhealthy diets, overweight and irregular physical activity. A review of 250 observational studies highlighted that higher consumption of fruits and vegetables in diets is associated with a 16 per cent lesser risk of cardiovascular deaths [10]. Several thrust research areas, such as genetics, genomics, molecular targeting, pharmacogenomics, stem-cell biology and regenerative medicine, are the key for future advances in cardiovascular science and drug development programmes.

Chronic obstructive pulmonary diseases

Chronic obstructive pulmonary disease (COPD) is the most common cause of chronic lung diseases globally. This progressive disease is characterized by increasing breathlessness due to persistent airflow limitation caused by different combinations of small-airway diseases. It includes a spectrum of conditions which include emphysema, chronic bronchitis, asthma (non-reversible) and some other forms of bronchiectasis (permanent enlargement of the airways of the lung) [11]. COPD primarily affects the structural units of pulmonary system by disrupting the mechanical process of respiratory air-flow and diffusion to blood. This limitation becomes progressive and thus lowers the blood O_2/CO_2 ratio significantly. This chronic condition thickens and disrupts the elasticity of pulmonary air sacs (alveoli), erosion of inter-alveolar septum and secrets excess of mucus that clog the air passage (Figure 3). Persons suffering from COPD necessarily suffer increasing breathlessness, frequent coughing, wheezing and tightening in the chest. Recent studies have also linked the occurrence of COPD to the development of lung cancer, irrespective of cigarette smoking dosage in the subjects [12].

Globally nearly 64 million people are affected by COPD according to WHO in 2004 and this number may touch 100 million by 2030. Epidemiological studies have predicted COPD to be the third leading cause of death globally in next couple of decades [13]. COPD is also has also emerged as one of the leading cause of mortality in India. Currently India harbours more than 556,000 cases of COPD (global share ~20%) and causes 102/100,000 deaths [14]. Actual cause of COPD is still unclear

however, extensive research has shown the association of persistent exposure to common lung irritants such as polluted air, hazardous suspended air particles and tobacco smoke, with the onset of COPD in general population. Genetic contribution however is limited, though has been shown to be critical in COPD [15]. Diagnosis of COPD is mainly based on the Lung function test, Chest x-ray or CT scan and arterial blood O_2/CO_2 measurement. COPD is not curable disease, however, can be managed well by lifestyle modifications such as quit smoking, avoiding lung irritants, regular exercise and supporting treatments medicines such as bronchodilators, inhaled glucocorticosteroids, flu vaccine etc. Clinical surgeries to open the bronchial blockage or to repair alveolar damages or even lung transplantation are necessary for patients with advanced stage of the disease.

Diabetes mellitus

Diabetes mellitus (DM) is the most common metabolic disorder affecting nearly 20% of global population today and expected to double the figure by 2030. Diabetes is regarded as one of the main causes of death across the globe and has become one of the most challenging health disorders of the 21st century [16]. Though earlier DM was thought to be disease of urban and privileged population, it is now found to be equally prevalent among rural or low income strata globally and in India [17]. Depending on the pathophysiology, DM can be classified into of two types, Type-1 diabetes mellitus (T1DM) and Type-2 diabetes mellitus (T2DM). Compare to T1DM, T2DM are less familial and mostly influenced by the environmental factors, unhealthy life style and food habits. A recent review suggests that the association of gut microbiome and interaction of these with genetic components of human is also very vital to determine the onset and the nature of DM [18]. T1DM comprises only 5% of total DM and seen among children or young adults who are unable to produce hormone insulin (insulin dependent DM, IDDM) due to loss of the insulin producing beta-cells of the Islets of Langerhans in the pancreas. Losses of beta cells are mostly mediated by the auto-antibody generated by the T-cells. *HLA-DQA1* and *PTPN22* are the most significantly associated genes with the pathogenesis of T1DM. On the other side, T2DM are mostly found among adults where cells fail to respond to insulin (non-insulin dependent DM, NIDDM). Unlike T1DM, in this case body cells develop reduced insulin responsiveness through insulin receptors on it and thus unable to respond to many intracellular metabolic signalling. Several life style changes are mostly associated with obesity which is indirectly influence the onset of T2DM in general population [19]. Insulin is the main hormone that regulates the glucose uptake by the muscle, adipose tissues and liver from circulating blood. Therefore, lower insulin level or disrupted insulin receptors both can deregulate the uptake of insulin from blood and necessary intracellular signalling. Elevated amount of blood glucose will then affect the efficiency of kidneys and other body organs like, eyes, brain tissues, cardiac tissue, distal parts of hand and legs. Common co-morbidities associated with DM are hypertension, dyslipidemia, non-alcoholic fatty liver disease, cardiovascular disease, kidney disease, retinopathy etc, which lowers the quality of life as well as economic stability of the society.

Symptoms of DM are heterogeneous and commonly identified as associated with physical abnormalities such as, early fatigue, frequent urination, excessive thirst, weight loss, increased huger, lack of interest and concentration, slow healing wounds etc. Generally symptoms are very prominent and sudden in case of T1DM in comparison to

T2DM. People suffering from different immune diseases or obesity have many fold greater chance to develop DM [20]. Diagnosis of DM are mostly done by testing the circulating glucose level in the blood in fasting condition (FPG, fasting plasma sugar) or after 2 hours post-meal (PP, postprandial glucose test). FPG level between 70-99 mg/dl are categorised as normal, >125 mg/dl are diabetic and individuals in between these threshold are grouped as pre-diabetic individuals who has higher risk of developing DM over the time (Table 1). Similarly for PP glucose level threshold for DM is >140 mg/dl. Other commonly performed tests are haemoglobin A1c (HbA1c) and oral glucose tolerance test (OGTT). Random plasma glucose (RPG) test, is sometimes performed to diagnose DM in regular health check-up camps.

Extensive epidemiological and clinical studies have revealed several preventive measures for mainly T2DM. However, individuals with family history of DM and predisposed genetic conditions are more prone to develop the disease condition over the period. Preventive measures are mostly to modify the life style such as, weight loss, increasing physical activity, avoiding fast food or preserved food, avoiding alcoholic and artificially sweetened beverages and smoking, increased intake of food rich in anti oxidants (green vegetables). Controlling blood pressure and serum lipid levels and reduced stress conditions are also important measures towards preventing the DM onset. DM is not a curable disease however; due to immense improvement in pharmacological and supportive clinical research several medicines are available to better management of the disease conditions. Commonly used first line of drugs includes Metformin, aspirin, angiotensin converting enzyme inhibitors (ACEIs) etc. Late stage T2DM and T1DM is typically treated with the Insulin injections.

Alzheimer's disease

Alzheimer's disease (AD) is the most common (60-80%) form of dementia and classified as major neurodegenerative disorder. AD is characterized by irreversible and progressive loss of memory and other intellectual abilities that can affect daily life. Though AD is not a normal part of aging, commonly found in older people (age >60 yrs.), however nearly 5% of the AD cases are of young onset. On Novembers, 1906, a clinical psychiatrist and neuro-anatomist, Dr. Alois Alzheimer presented a report on an unusual case study concerning a "peculiar severe disease process of the cerebral cortex" at the 37th Meeting of South-West German Psychiatrists, Tubingen. Dr. Alois Alzheimer first noticed changes in the brain tissue of a woman who died due to an uncommon mental disease [21]. The term 'Alzheimer's disease' was subsequently coined by Emil Kraepelin to honour his co-worker Alois Alzheimer. Formation of extracellular amyloid plaques and intracellular neurofibrillary tangles (NFT) are the primary features of AD which causes the significant shrinkage of brain size and loss of connection between nerve cells in the brain (Figure 4) [22].

Based on the pattern of memory loss and degree of neuronal impairment of the brain AD can be categorized into four stages namely (i) Pre-dementia, (ii) Early AD, (iii) Moderate AD, and (iv) advanced AD. Current study has shown that 1.5-2% people are suffering from AD in western countries and frequency is similar in India also [23]. Unknown environmental influences and genetic involvement are found to be associated with the onset of AD. Genes such as *APOE* (Apolipoprotein E), *A2M* (alpha-2-macroglobulin, *LRP1* (low density lipoprotein-related protein-1), *TF* (transferrin), *HFE* (hemochromatosis), *NOS3* (nitric oxide synthase 3) are among

the major contributors for AD (OMIM, NCBI http://www.omim.org/entry/104300). Heterogeneity in disease onset, pathogenesis and progression has made it tough to understand the disease. Clinical onset of AD varies from person to person and there is no single test that can detect or predict whether a person has AD and thus diagnosis is not so easy. Through clinical evaluation and family history counselling by Neurologists, Psychiatrists and Psychologists are necessary for the detection of primary symptoms based on which required blood testing and brain imaging are done to detect AD. Sophisticated brain image scanning like CT (computed tomography) and MRI (Magnetic resonance imaging), SPECT (Single photon emission computed tomography) and PiB (Pittsburgh compound B, a radioactive compound) mediated PET (positron emission tomography) are necessary to detect the brain tissue damage and formation of amyloid plaques.

Cure or preventive measure of AD is not known yet. However, several drugs are available or under trial which can be used to slow-down the progress of AD and prevent the associated discomfort of the patient and comorbidity. Early AD can be treated with Donepezil, a piperidine based inhibitor of acetylcholinesterase (AChE) [24] and Bapineuzumab, an anti-amyloid monoclonal antibody [25]. Recently stem cell therapy is also in trial with limited availability in western countries [26]. Modified life style including regular meditation, change in diet and physical activities are generally prescribed by physicians to improve the health of AD patients.

Cancer

Cancer is predicted to be become the most lethal disease in the next few decades causing highest morbidity and mortality across the world [1]. With the advancement in medical oncology, the challenges of diagnosing and curing cancer still remain enormous [2]. The WHO reported 12.7 million new cancer cases reported in the year 2008 (Figure 5) and forecasted 21.4 million new cases by 2030, with nearly two-thirds of all cancer incidences reported from low- and middle-income countries. In upper-middle-income and high-income countries, prostate and breast cancers are the most frequently diagnosed in males and females respectively, while lung and colorectal cancers is the second most common cancer respectively. Although these types cause most cancer-related deaths throughout the world but lung cancer is the most common cause in both sexes. In low-income countries, the lung and breast cancers remain the most commonly diagnosed cancer.

Based on the GLOBOCAN database, in the year 2002 about 10,862,496 new cancer cases (excluding skin cancer) were reported worldwide. Of these, 5,801,839 (53.4% of cases) were male while 5,060,657 (46.6% cases) were female (Ma X, Yu H, 2006). Further the database reports that about 45% of the new cases were from Asia, 26% from Europe, 15% from North America, 7% from Latin America, and 6% from Africa. Tobacco (contains several carcinogenic or cancer-causing compounds) use or exposure is the leading factor associated with oral cancer, lung cancer, hypertension, heart disease and several communicable diseases (such as tuberculosis and lower respiratory infections). Reports suggest that tobacco contains over 4000 chemicals, of which 50 are known to be carcinogenic. Currently there are about 1 billion smokers throughout the world consuming about 6 trillion cigarettes annually. WHO predicts that in India alone, about 700 billion ‘bidis’, a type of filter-less hand-rolled cigarette form, is consumed yearly [1].

Table.1 Showing the ranges of diagnostic parameters for diabetes mellitus. (Source: National Diabetes Information Clearinghouse, USA, http:// diabetes.niddk.nih.gov/dm/pubs/diagnosis/)

	HbA1c (%)	Fasting plasma glucose (mg/dL)	Oral Glucose Tolerance Test (mg/dL)
Diabetic	≥ 6.5	≥ 126	≥ 200
Pre-diabetic	5.7 - 6.4	100 - 125	140 - 199
Normal	About 5	≤ 99	≤ 139

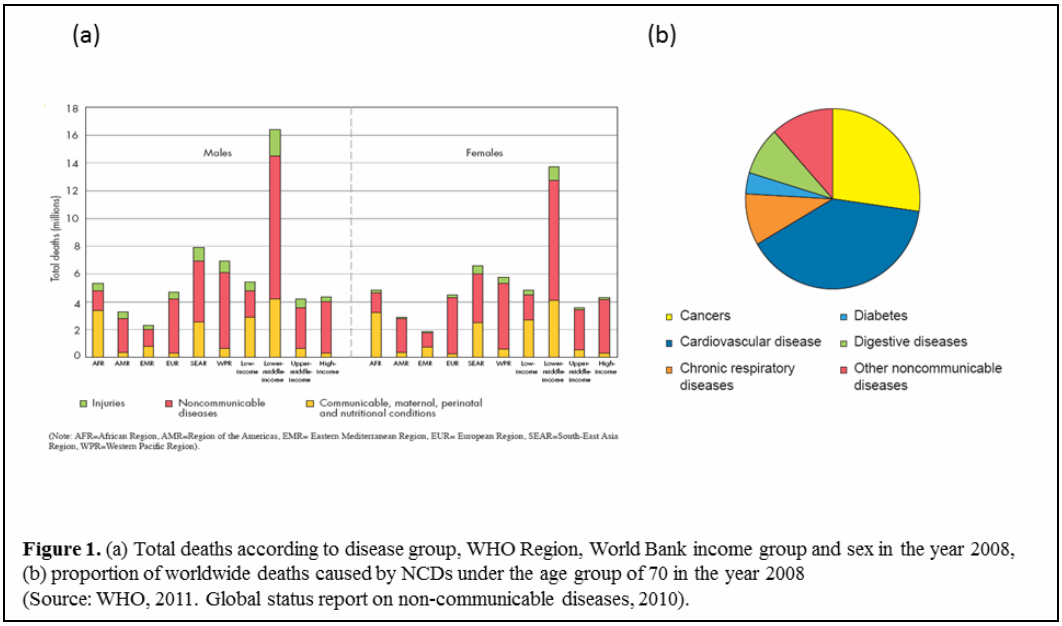

Figure 1. (a) Total deaths according to disease group, WHO Region, World Bank income group and sex in the year 2008, (b) proportion of worldwide deaths caused by NCDs under the age group of 70 in the year 2008 (Source: WHO, 2011. Global status report on non-communicable diseases, 2010).

Further insufficient physical activities, unhealthy eating habits and stress has also been associated with this life-threatening disorder [27]. A weekly 150 minutes of moderate physical activity is thought to reduce the risk of breast and colon cancer by 21–25% while about 30% and 27% in case of ischaemic heart disease and diabetes respectively. Researchers have found that there is a direct association among higher levels of alcohol consumption and increasing risk of few cancers, liver diseases and cardiovascular diseases. Estimates suggest that the harmful use of alcohol leads to about 4.5% of all the diseases with 2.3 million deaths in 2004. The World Cancer Research Fund Report predicted that 27–39% of the major cancers can be prevented by improved balance diet, proper physical activities and healthy practices.

Conclusion

Several epidemiological studies, randomized prevention trials, and numerous short-term intermediate endpoints reports such as on blood pressure, sugar and lipids have shown specific dietary habits and lifestyle determinants as the major factors giving rise to the chronic diseases (few of them discussed above). Certainly the urbanization process has caused poor lifestyle choices, such as smoking, overuse of alcohol, poor healthy diet, insufficient physical activity and chronic stress, leading to development and progression of various chronic diseases. Even though doctors and social media

encourage us for healthful habits to help prevent many-of-these chronic medical disorders, but we generally ignore or are reluctant to either start or maintain these appropriate, healthy behaviours. Nevertheless, healthy lifestyle methods are now easily achievable with appropriate interventions, like nutritional counselling, exercise training, de-addiction programmes, regular medical checkups and stress management techniques [28]. A general conclusion from most of the genetic and epidemiologic studies have strongly suggested that reducing identified occupational hazards, modifying dietary habits and changing lifestyle-risk aspects could avert most cases of cardiovascular disorders, stroke, diabetes, neurological diseases and many types of cancers.

Source of financial support: Ramjas College, University of Delhi, India

Acknowledgements

SS and AB are grateful to Ramjas College, University of Delhi for all the support. NB is thankful to Dyal Singh College, University of Delhi for the support.

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