Iran J Public Health, Vol. 51, No.11, Nov 2022, pp.2382-2387

Review Article

Hypothetical Strategies of Gene and Environmental Influence on Life Expectancy: A Brief Review

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(Received 11 Jul 2022; accepted 15 Sep 2022)

Abstract

Almost all diseases have a genetic basis. However, several disorders stem from a combination of genes and environmental conditions. In the present study, databases including PubMed, Scopus and Google scholar were searched and reviewed and those relevant studies that investigated the association between environmental and genetic factors with the incidence of diseases were extracted and used. At the final step, it is concluded that in many cases, disorders have a multifactorial etiology. Having a gene related to a specific disorder is not the only reason for contracting the disease. Both genes and environmental factors play a role in human disease etiology. Everything outside of DNA, may affect health and even in many people with a positive family history of a specific disorder, environmental factors can facilitate or prevent the occurrence of the disease. Therefore, living a healthy lifestyle is important in reducing exposure to diseases, and long-life expectancy.

Keywords: Genetic disorders; Lifestyle; Life expectancy; Environmental factors

Introduction

Genetic conditions account for a significant portion of disorders in the world's population, including single gene, multifactorial and mitochondrial inheritance, and chromosome abnormalities (Fig. 1).

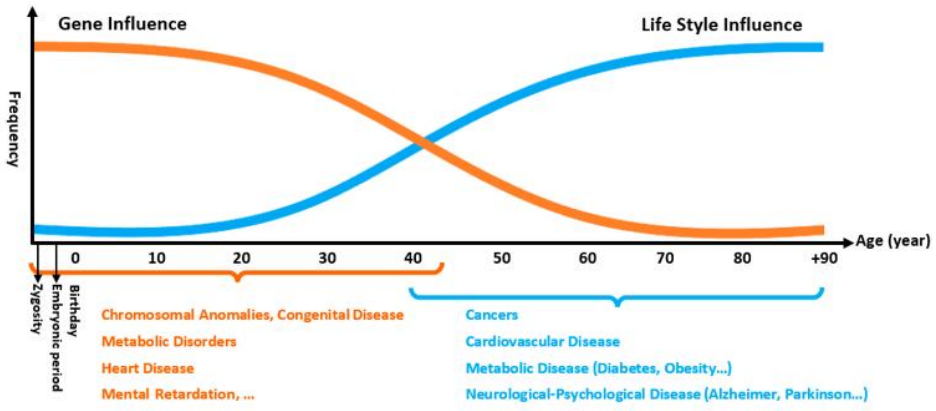

Fig. 1: The effect of genetic and life style on diseases with aging (Original)

Among many genetic disorders affecting people from the first days or years of life, multifactorial diseases have a genesis influenced by both environmental factors and genes. From birth to the early 40s, diseases can be classified into three categories based on their occurrence: early, middle, and late onset. Hereditary syndromes are those genetic, disorders often associated with the onset of the typical symptoms in the first weeks or months of postnatal life. Various emerging approaches in medical genetics have been applied to identify mutations in patients with early-onset genetic diseases, specifically de novo mutations that have not been previously reported or were absent in population controls. The occurrence of several non-communicable diseases such as metabolic syndromes, mental illnesses, and early onset heart defects are also in childhood or teen years (1-2).

Modern life has brought about extensive changes in the lives of all people and general health status (3). Improved diagnostic tests and techniques in detecting hereditary and genetic conditions aid specialists in early detection, making decisions, and managing these disorders, and also plan to prevent diseases. These improvements in people's lives and the healthcare system have reduced infant mortality and improved life expectancy. However, these changes in modern life increase the risk of contracting other diseases significantly, dependent on lifestyle (3-5).

In fact, quality of life may lead to the occurrence of those diseases in which the susceptibility to them lays dormant at least until middle or old age and is influenced by a combination of genetic and environmental factors. Some of these factors notably include poor diets, alcohol consumption, smoking, substance abuse, lack of physical activity, sleep deprivation or oversleeping, risky sexual behavior and habits, and excessive use of technology. These habits increase the risk of chronic and non-communicable diseases. Chronic diseases, including cardiovascular diseases, cancers, metabolic (obesity, diabetes,...), and mental disorders account for approximately 80% of all years of disability and more than 85% of health care costs and are responsible for 77% of deaths around the world (6-8).Various studies have long established that several chronic conditions linked to a genetic predisposition and different systematic errors in interpreting the genome contribute to chronic diseases (9-10).

Cardiovascular Diseases

Cardiovascular diseases (CVDs) are the leading cause of death. Various types of research have revealed that several cardiac disorders exhibit the influence of genetic mutations and the role of inheritance, which can result in heart failure symptoms, high blood pressure, and increasing arterial plaque build-up, or affect the structure of the heart muscle, the way that heart cells communicate, the structure and function of a particular protein in the circulatory system, and processing cholesterol. Therefore, genetic factors can affect the likelihood of cardiovascular diseases due to the importance of genes in every aspect of the cardiovascular system. These conditions are passed on through families and are called inherited cardiac conditions (11).

Apart from hundreds of genes involved in cardiac disease, there are also tens of high-risk environmental factors influencing CVD risk, incidence, and severity. The elderly population is intrinsically more vulnerable to CVDs than younger people since aging is consistently associated with an increased likelihood of exposure to risk factors and impairs the cardiovascular system (12). Insufficient physical activity, being overweight, elevated serum cholesterol levels, high blood pressure, smoking, pesticides, pollution levels, and extremes in noise and temperature are leading risk factors for CVDs in those individuals with positive family history (13).

Cancers

Although cancer is a common genetic disease, only 5 to 10 percent of all cancers are hereditary. Mutations in some specific genes may predispose people to develop cancers. According to studies, the percentage of cancers observed in young adults is lower than in older adults, but the incidences are increasing. Research in the United

States shows that the number of young people diagnosed with cancer between the ages of 20 and 40 is about 80,000 individuals per year. Meanwhile, the latest data and statistics on cancer indicate that the prevalence of breast, uterus, colon, kidney, and pancreatic cancers is increasing among younger age groups (14). However, this number is still only 5% of diagnosed cancers.

Therefore, apart from the effect of age as the main factor in the steadily overall climb of incidence rates for cancer, it can be understood that environmental factors and lifestyle are of great importance in contracting a majority of cancers, specifically among adults younger than 50. Simply put, an unhealthy lifestyle not only leads to early-onset cancer in people prone to this disease but can also raise the risk of developing cancer in normal people with negative family history. Poor living conditions, including cigarette smoking, pollution, high stress, an unhealthy diet like consuming red meat, processed foods and low fruit vegetable intake, alcohol, infectious exposures, obesity, and insufficient physical exercise are the main environmental factors that cause cancers and are associated with significant increases in disease risk (15).

Metabolic Disorders (Diabetes and Obesity)

Diabetes is caused by both environmental factors and strong hereditary components. According to various investigations, genetics and lineage play a vital role in type2 diabetes and development of type 1. People with first-degree relatives suffering from T2D are three times more likely to develop diabetes than those without a positive family history. Several genes are known to be linked with this condition. At the molecular level, approximately more than 80 genes have been identified as associated with complications (16). However, carrying a mutation doesn't cause diabetes alone. Environment and lifestyle can accelerate the onset of this disease. According to the National Health and Nutrition Examination Survey (NHANES), an obesogenic diet and lack of physical activity are known to be a major driver of obesity and T2D in most affected cases (17).

New research directions explain how the environment during critical periods of human growth and development affects obesity and diabetes due to the epigenetic influences on gene expression, like chemical modifications of DNA and RNA and subsequent protein expression or resulting in metabolic alterations (18-19).

Therefore, considering the importance of lifestyle and aging in the occurrence of this highly hereditary disease, its prevention, and treatment, it is necessary to have a healthier diet to lower blood glucose levels, increase daily physical activity to promote cardiovascular and respiratory functions and eliminate unhealthy behaviors like smoking, consuming excessive amounts of alcohol and inadequate sleep.

Neurological Disorders (Alzheimer's disease)

Previous studies on Alzheimer's disease (AD) have reported two types of AD—early-onset and late-onset. The leading cause of early-onset AD is genetics which occurs between a person's 30s to mid-60s and makes up about 5-6% of the population of Alzheimer's patients (20). Single gene mutations including, Amyloid precursor protein (APP) on chromosome 21 (21), Presenilin 1 (PSEN1) on chromosome 14, and Presenilin 2 (PSEN2) on chromosome 1 (22), have been observed to be associated with early-onset AD and result in abnormal proteins production. On the other hand, the most important and known risk factor of late-onset AD is increasing age and the majority of patients identified with the disease are in their mid-60s and later. Although no specific gene is associated with late-onset AD, identifying genetic variants has helped scientists better understand AD and find genetic risk factor. Therefore, according to their findings, having a genetic variant of the apolipoprotein E (APOE) gene is associated with the increasing risk of developing late-onset AD. APOE ε2 usually causes AD later in life, unlike APOE ε4, which is responsible for developing AD at an earlier age. However, because of inheriting these genes from parents, people do not definitely get the disease. Certain environmental factors, including exposure to pollution, persistent organic pollutants, cigarette

smoking, infections, less exercise, and aluminum and selenium in drinking water, appear to be linked to an increased risk of Alzheimer's disease. On the other hand, researchers concluded through meta-analysis that there is a significant association between low serum vitamin D concentrations and prevalent AD. Therefore, this chronic disease is caused by age-related degeneration, genetic and lifestyle factors (23).

In a nutshell, lifestyle affects individuals' health, and adopting a healthy lifestyle can prevent people from getting diseases by aging. Environmental risk factors play a vital role in the pathogenesis of many diseases, especially chronic diseases. Multiple conditions, including metabolic, neurocognitive and neurodegenerative, cardiovascular, and autoimmune diseases, cannot be ascribed only to one factor. Therefore, having a gene related to a specific disease and mutations are not the only reasons for contracting a disease. Even in many people with a positive family history of genetic disorders, environmental factors can facilitate or prevent the occurrence of a disorder (24-25) (Fig. 2).

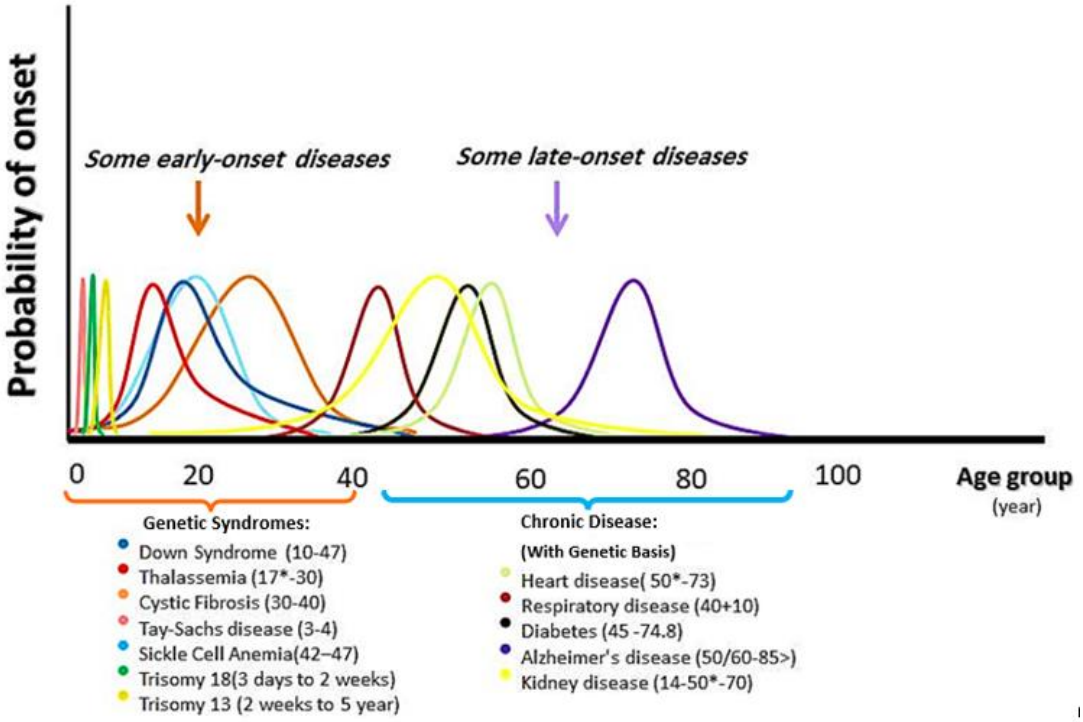

Fig. 2: Onset of some diseases (26-36)

Conclusion

Life Expectancy is influenced by genetic, epigenetic and environmental factors. Lifestyle, such as human behavior, nutrition, stress, working habits, physical activity, smoking and alcohol consumption can impact on epigenetic. It appears that appropriate lifestyle changes may have contributed to world-wide increase in human longevity in the future.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

No financial support was received for this study.

Conflict of interest

The authors declare that there is no conflict of interest.

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