The role of diet and physical activity in preventing chronic diseases: a comprehensive review

El papel de la dieta y la actividad física en la prevención de enfermedades crónicas: una revisión integral

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Abstract

Introduction: Non-communicable diseases, which include cardiovascular disease, diabetes mellitus, obesity, and malignancies, cause nearly 70% of deaths worldwide and pose a significant burden in many low- and middle-income countries.
Objective: The present article reviews the various dimensions of dietary and physical activities that may prevent or manage chronic diseases, especially concerning implications regarding morbidity and mortality reduction.
Methodology: This includes an interaction between modifiable lifestyle factors and more distal determinants, including socioeconomic, environmental, and genetic predispositions that all determine health outcomes. Some of the most important findings concern dietary patterns such as Mediterranean and plant-based diets and physical activity in the reduction of inflammation, improvement in metabolic health, and promotion of long-term prevention of diseases. Innovative interventions, such as digital health tools and social prescribing, are considered ways of enhancing self-management and community engagement. Similarly, the review highlights what is implied to be an elimination of barriers against healthy behaviors, such as access to healthy, affordable nutritious food and safe environments for physical activity.
Discussion: Policymakers, health providers, and community organizations are therefore encouraged to collaborate in formulating integrated approaches toward promoting health equity.
Conclusion: With all this in mind, the comprehensive analysis does underscore a need for holistic, multidisciplinary approaches in managing the rising tide of NCDs in maintaining the public health gains globally.

Keywords

Chronic diseases; diet; digital health technologies; lifestyle interventions; noncommunicable diseases; physical activity; socioeconomic factors.

Resumen

Introducción: Las enfermedades no transmisibles, que incluyen enfermedades cardiovasculares, diabetes mellitus, obesidad y neoplasias malignas, causan cerca del 70% de las muertes a nivel mundial y representan una carga significativa en muchos países de ingresos bajos y medianos.
Objetivo: El presente artículo revisa las diversas dimensiones de la dieta y la actividad física que pueden prevenir o manejar las enfermedades crónicas, especialmente en lo que respecta a la reducción de la morbilidad y la mortalidad.
Metodología: Se analiza la interacción entre factores modificables del estilo de vida y determinantes más distales, incluyendo predisposiciones socioeconómicas, ambientales y genéticas que influyen en los resultados de salud. Algunos de los hallazgos más importantes se refieren a patrones dietéticos como la dieta mediterránea y las dietas basadas en plantas, así como la actividad física en la reducción de la inflamación, la mejora de la salud metabólica y la promoción de la prevención a largo plazo de enfermedades. Se consideran intervenciones innovadoras, como las herramientas de salud digital y la prescripción social, como formas de mejorar el autocuidado y la participación comunitaria. De igual manera, la revisión resalta la importancia de eliminar las barreras para adoptar comportamientos saludables, como el acceso a alimentos nutritivos, asequibles y entornos seguros para la actividad física.
Discusión: Por lo tanto, se alienta a los responsables políticos, proveedores de salud y organizaciones comunitarias a colaborar en la formulación de enfoques integrados para promover la equidad en salud.
Conclusión: En este contexto, el análisis integral subraya la necesidad de enfoques holísticos y multidisciplinarios para gestionar el creciente desafío de las enfermedades no transmisibles y mantener los logros en salud pública a nivel global.

Palabras clave

Actividad física; dieta; enfermedades crónicas; enfermedades no transmisibles; factores socioeconómicos; intervenciones sobre el estilo de vida; tecnologías digitales de salud.

Introduction

Noncommunicable diseases have been one of the significant challenges facing global health as they make up a big proportion of morbidity and mortality. Bennett et al. stated that NCDs account for around 70% of the total deaths, which disproportionately affect the low- and middle-income nations and poor people in the high-income nations (Bennett et al., 2018). This is an alarming statistic that calls for massive public health interventions in preventing and managing chronic diseases increasingly known to be essential components of global health initiatives. The global burden of chronic diseases is multifaceted because it involves interactions between lifestyle risk factors, environmental exposures, and genetic predispositions. For example, obesity has been defined as one of the major risk factors in the emergence of most chronic conditions such as cardiovascular diseases, type 2 diabetes, and hypertension that have been widely defined as metabolic syndrome (Lascaris et al., 2018).

It has been shown that there is a correlation of alarming rates of obesity with diet change and a sedentary lifestyle, raising serious concern among the health care systems globally (Nobili et al., 2011). Moreover, both diseases such as diabetes and hypertension are related, and each feed on the other, forming a vicious cycle of worsening health outcomes (Leong et al., 2018). CKD is one of the most significant examples of the huge health burden chronic diseases place on individuals. CKD is highly morbid and fatal, with an estimated prevalence of 13.4% globally, especially among those with comorbid conditions such as hypertension and diabetes (Rashid et al., 2022). CKD is challenging to control since it seems to be often associated with other chronic diseases that, in a way, have a chain reaction of health issues, such as cardiovascular disease and rising healthcare expenditures (Piras et al., 2017). This association makes the necessity of a care model addressing more than one chronic condition simultaneously necessary instead of in isolation.

Furthermore, chronic diseases are related not only to health but also to both economic productivity and social stability. The World Health Organization made a point that the economic burden of NCDs can trap development efforts in low-income countries whose healthcare resources are under strain already (Bennett et al., 2018). It means the chronic disease contributes to increasing expenditure on health, loss in terms of productive working time due to sickness, and quality of life being reduced. The treatment of chronic diseases thus forms a priority from both a health and economic standpoint. The pandemic of COVID-19 further illuminated the vulnerabilities of chronic diseases. Chan and Horne note the possibility of a "post-pandemic double burden of disease," wherein the chronic disease management is dominated by the immediate needs of pandemic response (Chan & Horne, 2021). In this regard, the pandemic has emphasized the need to keep attention to chronic disease management even when public health emergencies occur. Exacerbating existing health disparities, this pandemic has heightened the risk for worse outcomes with those who are chronically diseased. They face a risk of a worse COVID-19 outcome. Chan and Horne report this (2021).

Given the rising levels of chronic disease, innovative interventions like social prescribing have become trendy. This strategy aims to tackle the social determinants of health by linking people to community resources for health and wellbeing ("Call for papers: Social Prescribing in Canada", 2023). Social prescribing supports social connection and other non-medical needs, hence preventing chronic diseases and enhancing health outcomes. According to research, such interventions can enhance health at the individual and community levels, thereby reducing the overall chronic disease burden ("Call for papers: Social Prescribing in Canada", 2023). In addition, lifestyle modification cannot be underrated in the management of chronic conditions. Interventions targeted at diet, physical activity, and smoking cessation successfully reduced the incidence and progression of chronic conditions (Nobili et al., 2011). For example, lifestyle interventions have been found to make substantial impacts in patients with chronic liver disease, hence underlining the role of prevention in managing chronic health issues (Nobili et al., 2011).

Epidemiology of Chronic Diseases

Cardiovascular diseases are the leading cause of death globally, accounting for about 32% of all deaths, at a staggering rate of about 17.9 million fatalities annually (Mehta et al., 2022). The occurrence of CVDs is very alarming in low- and middle-income countries, where the fragile healthcare systems find it dif-

ficult to handle these conditions (Asogun, 2024). Risk factors for developing CVDs include hypertension, high cholesterol levels, and diabetes. These factors contribute to about 13% of global deaths (Us et al., 2013). With an increase in obesity and sedentary lifestyle, there is a high level of cardiovascular disease, hence calling for urgent public health interventions with lifestyle modification and early detection (Rekia, 2017). Another increasingly emerging chronic disease is diabetes, whose prevalence rates worldwide are estimated to be approximately 9% based on the year 2014. This is expected to increase very rapidly in the following years (Bromage & Yellon, 2015). Diabetes, according to the WHO, is almost related to other chronic diseases, mainly CVDs. Cardiovascular complications are responsible for the largest number of deaths among diabetic patients (Bromage & Yellon, 2015). Socioreconomic factors do indeed play significant roles in diabetic prevalence since reports argue that low schooling attainment is among the risk contributors to diabetes in recent studies done (Xu et al. 2017). Diabetes has a burden imposed upon it especially when considering ageing population and obestiy are going to sky-rocket: calls for sharp and immediate actions at the community levels in curtailing these simultaneous epidemics trend.

Obesity is that condition where more than the actual amount of body fat is kept in the body. A critical risk factor for many chronic diseases, among them diabetes and CVDs, obesity results in an excessively high prevalence, with estimates claiming that over 650 million adults are classified as obese in 2016 (Mohammed-Ali et al., 2015). Poor diet, physical inactivity, and socioeconomic inequality have been mentioned among the risk factors that attribute to increasing trends in obesity levels (Mohammed-Ali et al., 2015). While obesity doubles the risk for chronic diseases, it complicates their management, and the healthcare cost rises and the health outcomes deteriorate as well (Mohammed-Ali et al., 2015; Maher et al., 2010).

Another significant contributor to the global burden of chronic diseases is cancer. Millions of new cases are diagnosed every year. According to IARC, there were about 19.3 million new cases of cancer and nearly 10 million cancer deaths in 2020 (Mehta et al., 2022). Prevalence of cancer is further influenced by different risk factors like tobacco use, alcohol consumption, and environmental exposures. Furthermore, the emerging trend of overweight and obesity is associated with a substantially increased risk for cancer, although it includes some specific categories of cancer - breast and colorectal cancer for example (Mohammed-Ali et al., 2015; Maher et al., 2010). The complexity associated with the treatments of cancer requires long time care, whereby early detection becomes an important function in reducing morbidity as well as cancer-related mortality rates.

CKD is increasingly recognized as a global health problem. An estimated 10.6% of adults have CKD. CKD tends to accompany other chronic diseases like diabetes and hypertension, thereby leading to comorbidity cycles, which further make treatment and management complicated (Mohammed-Ali et al., 2015; Khalid et al., 2021). A rising concern in the prevalence of CKD has been observed, particularly among the elderly and those lacking even the most fundamental health resources, and hence early detection and management are primarily deficient (Mohammed-Ali et al., 2015; Khalid et al., 2021). Another extremely prevalent chronic disease is hypertension or high blood pressure. As estimated, about 1.56 billion people worldwide suffer from it (Mantimane, 2019). It is a significant risk factor for both CVDs and CKD, and it accounts for an enormous burden of the disease worldwide (Us et al., 2013; Mantimane, 2019). Hypertension is more common among the population of low- and middle-income countries, for whom health care systems are not adequately developed for the management of the condition (Musinguzi & Nuwaha, 2013). Some key public health strategies for controlling the effect of hypertension on global health are the promotion of healthy lifestyle habits and routine screening.

This review scope and objective entail a comprehensive examination of the impact of chronic diseases on health across the world. The scope would be broad enough to consider their prevalence, related risk factors, and the effects on health systems around the globe. Chronic diseases, such as cardiovascular diseases, diabetes, chronic respiratory diseases, and cancers, are now well recognized as major causes of morbidity and mortality worldwide. The aim of the review is synthesis of available literature to depict the urgent need for effective prevention and management strategies, particularly in low- and middle-income countries (LMICs) where the burden of these diseases is disproportionately high (Labonté et al., 2011; Aikins et al., 2010). The prime aim of the review is to shed light on the interaction existing between chronic diseases and other social determinants of health. Chronic diseases are not a disease,

but they have various influencing factors like socioeconomic status, lifestyle, and environmental exposures. This review involves discussing factors such as lifestyle changes, urbanization, and an alarming rising prevalence of obesity that is highly dangerous and contributes to most chronic diseases (Al-Jamimi, 2024; Aikins et al., 2010). Through this review, it will show how such risk factors lead to an increased disease burden of chronic diseases and create a burden to the healthcare sectors, especially the LMIC that has limited resource availability (Labonté et al., 2011; Aikins et al., 2010).

Method

The review will be able to talk about the mental health consequences, too. There is a need to include psychosomatic principles in the management of chronic diseases because mental health disorders usually accompany chronic physical conditions, worsening health outcomes (Bauer et al., 2010). The review will explain the importance of holistic approaches to health care, which include mental health support as part of the treatment for chronic diseases (Bauer et al., 2010; Greenberg et al., 2011). Another significant feature of this review is the identification of innovative solutions and interventions to improve chronic disease management. It has been proven that mobile health (mHealth) technologies promise to enhance treatment adherence and patient outcomes through personalized interventions (Hamine et al., 2015). This review will be able to analyze the potential that such technologies offer in enhancing self-management and treatment adherence, hence reducing the burden of chronic diseases on healthcare systems (Hamine et al., 2015).

The review will also consider the economic impact of chronic diseases because they are proven to place heavy burdens on the individual and health care systems. Chronic diseases are among the primary causes of health care expenditure, and most often, their treatment requires extended care and resources (Marešová et al., 2019). The review will be based on the economic burden of chronic diseases and advocate for policies that are more preventive and early intervention to reduce these costs (Al-Jamimi, 2024; Marešová et al., 2019). This paper will focus on education and awareness as the most important elements in preventing and managing chronic diseases. Self-management and health literacy education programs have enabled patients to gain better control of their health outcomes (Ruiz-Ramírez et al., 2021; Wang et al., 2015). Awareness development and education role in fighting chronic diseases among vulnerable populations will be discussed as part of public health programs (Greenberg et al., 2011).

Results

Key Risk Factors Associated with Chronic Diseases

Table 1. The modifiable risk factors and description.

Risk Factor	Description	Citations
Unhealthy Diet	A diet high in saturated fats, trans fats, sugars, and sodium contributes to obesity, hypertension, dyslipidemia, and cardiovascular diseases, such as atherosclerosis.	Muneshwar et al., 2017
Physical Inactivity	Sedentary lifestyles increase the risk of obesity, type 2 diabetes, and cardiovascular diseases. Regular exercise improves cardiovascular health.	Muneshwar et al., 2017
Obesity	A major risk factor for diabetes, hypertension, and certain cancers, linked to poor diet and inactivity. Prevalence is globally high, increasing chronic disease burden.	Mingou, 2019; Muneshwar et al., 2017
Smoking	Tobacco use significantly increases the risk of cardiovascular diseases and cancers. Secondhand smoke also poses public health risks.	Muneshwar et al., 2017
Excessive Alcohol	Heavy alcohol use causes hypertension, liver disease, and cancers. Moderate consumption may have cardiovascular benefits but excessive use is harmful.	Muneshwar et al., 2017
Hypertension	A "silent killer" that can lead to heart failure, stroke, and kidney disease. Managed through diet, exercise, and other lifestyle modifications.	Muneshwar et al., 2017; - et al., 2023
Dyslipidemia	High LDL and low HDL cholesterol levels increase cardiovascular disease risk. Managed through diet, exercise, and medications.	Muneshwar et al., 2017
Diabetes	Increases the risk of cardiovascular diseases and complications like neuropathy, retinopathy, and kidney disease. Effective blood sugar management is essential.	Undela & Gopal, 2014; Armenian et al., 2016

Table 2. The non-modifiable risk factors and their description

Risk Factor	Description	Citations
Age	The likelihood of developing chronic diseases increases with age. Older adults often experience multiple chronic conditions, complicating treatment and management. Aging leads to physiological changes that predispose individuals to issues such as cardiovascular diseases and diabetes.	Mingou, 2019; Leening et al., 2014
Gender	Significant differences exist in the prevalence and manifestation of chronic diseases between men and women. For instance, postmenopausal women have a higher risk of certain cardiovascular conditions. Understanding gender differences is essential for creating tailored prevention and treatment strategies.	Mingou, 2019; Leening et al., 2014
Family History	A family history of chronic diseases increases risk due to genetic predispositions and shared environmental factors. Genetic factors play a role in susceptibility to conditions like hypertension, diabetes, and specific cancers.	Agbana et al., 2016; Nasiłowska-Barud & Barud, 2020
Ethnicity	Certain ethnic groups face a higher risk of chronic diseases due to genetic, environmental, and socioeconomic factors. For instance, African Americans have elevated rates of hypertension and diabetes. Tailored public health interventions are necessary to address these disparities effectively.	Agbana et al., 2016; Nasiłowska-Barud & Barud, 2020

Physical Activity and Chronic Disease Prevention

Table 3. Types of physical activity and description.

Exercise Type	Description	Citations
Aerobic Exercise	Such exercises are walking, running, cycling, and swimming. Aerobic exercises help improve cardiovascular health, thus lowering the danger of chronic diseases. There is strong evidence that regular physical activity, with at least 150 minutes of moderate-intensity aerobic exercise per week, will reduce the risk of heart disease and stroke significantly. Such activities include brisk walking, which can be easily fitted into daily life.	Shiroma et al., 2014; Samitz et al., 2011
Resistance Training	Strength training is the lifting of weights or resistance bands, which builds muscle mass and improves metabolic health. Resistance training increases the body's sensitivity to insulin, which reduces body fat, thus lowering the risk of type 2 diabetes and cardiovascular diseases. The American College of Sports Medicine recommends strength training at least two days a week.	Anderson & Durstine, 2019; Alves et al., 2016
Flexibility and Balance Exercises	Activities that enhance flexibility and balance, such as yoga and tai chi, are beneficial, especially for older adults and individuals with chronic conditions. These exercises improve mobility, reduce fall risk, and enhance overall quality of life. They also help manage chronic diseases by increasing functional capacity and alleviating pain, such as that caused by arthritis.	Tama & Astutik, 2022
High-Intensity Interval Training (HIIT)	HIIT involves alternating between short bursts of intense exercise and periods of rest or lower-intensity activity. This training method is efficient in improving cardiovascular fitness and metabolic health. HIIT has been shown to reduce body fat and improve insulin sensitivity, making it a valuable tool for preventing chronic diseases.	Mandili et al., 2022; Anderson & Durstine, 2019

Table 4. Biological Mechanisms of Physical Activity in Chronic Disease Prevention

Mechanism	Description	Citations
Metabolic Improvements	Physical activity enhances metabolic health by improving insulin sensitivity, which is crucial for glucose metabolism. This reduces the risk of type 2 diabetes and metabolic syndrome. Exercise stimulates glucose uptake by muscle cells, lowering blood sugar levels. Regular exercise also promotes favorable lipid metabolism, increasing HDL cholesterol and reducing triglycerides and LDL cholesterol, lowering cardiovascular disease risk.	Singh et al., 2013; Lynch, 2010; Pedersen & Saltin, 2015
Hormonal Regulation	Exercise affects hormones such as endorphins, which elevate mood and lower stress levels, so it may indirectly reduce the risk of chronic diseases caused by stress. It also changes sex hormones such as estrogen and testosterone, which have been linked to specific cancers. Exercise lowers insulin and IGF-1, which reduces the risk of cancers associated with metabolic syndrome.	Zouhal et al., 2022; Lefferts et al., 2022; Claypool & Cj, 2018; Singh et al., 2013
Anti-Inflammatory Effects	Regular exercise reduces chronic inflammation by decreasing pro-inflammatory cytokines and increasing anti-inflammatory cytokines, which help mitigate the risk of diseases like cardiovascular disease, diabetes, and cancer. Exercise also reduces visceral fat, which contributes to systemic inflammation, further lowering the risk of chronic diseases.	Walzik et al., 2021; Zouhal et al., 2022
Cellular and Molecular Adaptations	Exercise leads to cellular and molecular changes, such as the expression of microRNAs that regulate muscle development and metabolism. Such adaptations improve muscle function and metabolic health, thus reducing the risk of diseases such as sarcopenia and obesity. Exercise also leads to mitochondrial biogenesis, enhancing energy metabolism and reducing the risk of chronic diseases such as type 2 diabetes and cardiovascular diseases.	Altana et al., 2015; Pedersen & Saltin, 2015
Improved Immune Function	Regular physical activity helps to improve circulation of immune cells, thereby enhancing the capacity of the body to respond to infections. Moderate exercise has immunomodulatory effects that promote a balanced immune response, helping to prevent chronic diseases linked to immune dysfunction.	Zouhal et al., 2022

Table 5. Combined Impact of Healthy Dietary Practices and Regular Physical Activity.

Mechanism	Description	Citations
Complementary Effects on Metabolic Health	Both diet and physical activity are essential for regulating metabolic processes. Regular exercise enhances insulin sensitivity and glucose metabolism, thereby significantly reducing the risks of type 2 diabetes and metabolic syndrome. Diet supplemented with whole grains, fruits, vegetables, and lean proteins significantly enhances these benefits, with improved control of body weight, improvement in lipid profiles, and lower blood pressure being the end results.	Lahiri et al., 2022
Enhanced Anti-Inflammatory Effects	Diet and physical activity share anti-inflammatory properties that are involved in reducing chronic diseases, including cardiovascular disease, diabetes, and cancers. Physical activity lowers the pro-inflammatory cytokines, whereas diet with rich antioxidants such as vitamins C, E, omega-3 fatty acids reduce the inflammatory response even more. Together, these strategies markedly decrease systemic inflammation.	Zouhal et al., 2022; Olza et al., 2017
Improved Weight Management and Body Composition	Proper weight management prevents chronic diseases. Diet and exercise both have significant roles to play in it. Combining diet and exercise together proves better in controlling weight and reducing body weight as compared to any single factor. Such a diet-exercise regimen helps in the prevention of diseases related to obesity, including type 2 diabetes and cardiovascular diseases.	Dyson, 2010
Psychological and Behavioral Interactions	Another level at which the relationship between diet and physical activity extends is psychologically and behaviorally. Exercise maintains good mood, reduces stress levels, and helps one eat well. Conversely, a healthy diet boosts energy, and therefore an individual feels much motivated to do exercise. So, the above relationship goes two ways in enhancing health.	Samuel et al., 2020; Alzaben, 2023
Long-Term Health Benefits	The benefits of combining a healthy diet with regular physical activity are well known. A systematic review revealed that people who live an active lifestyle and consume a healthy diet tend to have a reduced mortality rate and lower risks of chronic diseases like cardiovascular disease, type 2 diabetes, and certain cancers.	Reiner et al., 2013
Practical Implications for Public Health	Public health initiatives that encourage healthy eating and physical activity together are more effective than focusing on one aspect alone. Community-based interventions that integrate nutrition education with physical activity programs improve health outcomes, especially in populations at risk for chronic diseases. Addressing barriers to healthy eating and exercise is also crucial.	White et al., 2016; Hu et al., 2011

Discussion

Psychological and Environmental Factors

Stress

Chronic stress has been associated with several health problems, including hypertension and cardiovascular diseases. Stress can further lead to maladaptive coping behaviors that may contribute to unhealthy eating habits and sedentary lifestyles, leading to health hazards (Nasiłowska-Barud & Barud, 2020; Blacher & Femery, 2021).

Environmental Factors

The lack of availability of healthy food or safe areas to play leads to poor living habits, which then expose people to risk factors for chronic diseases (Agbana et al., 2016; Nasiłowska-Barud & Barud, 2020). The public health strategies need to address environmental factors as well. Chronic diseases can be broadly categorized into modifiable and non-modifiable risk factors. There are various risk factors that predispose one to chronic diseases. It is imperative to identify and understand these various risk factors so that the right kind of prevention and management strategy may be evolved to tackle chronic diseases. Among all chronic diseases, CVDs, diabetes, obesity, and some cancers top the list. All of them have a common set of risk factors, which explains their incidence and prevalence.

Diet and Chronic Disease Prevention

Impact of Dietary Composition on Chronic Disease Prevention

Dietary Diversity and Prevention of Chronic Diseases

The definition of dietary diversity is the variety of food items consumed. A diversified diet plays a vital role in the prevention of metabolic-related outcomes. Mozaffari et al. describe that the diversity of intestinal microbiota may be enhanced through a diversified diet. It is critical for homeostasis and enhanced immune function (Mozaffari et al., 2021). Diverse intake ensures essential micromarkers and bioactive compounds, that are combined into the reduction of the risk to develop chronic disorders. This context, especially during metabolic disorders has a direct lack in dietary variety being associated with bad health-related results (Mozaffari et al., 2021).

Plant-Based Food

Increasingly more news surrounds a huge uptake in fruits, vegetables, whole grains, and legumes which retain a long association with lowered chronic disease risks. Such diets end up full of good ingredients rich in fiber and antioxidants, thus entailing additional benefits for health. For example, Chen et al. indicated that subjects who had diet-related chronic diseases rated the diet quality to be high when it was a plant-based dietary pattern (Chen et al., 2011). Fruits and vegetables consumption has been shown to lower blood pressure, lower cholesterol concentration, and improve glycemic control hence lowering risk factors for cardiovascular disease and diabetes (Cena & Calder, 2020).

Influence of Ultra-Processed Foods

It is associated with chronic diseases. High intakes of saturated fats, refined sugars, and processed foods are believed to be associated with chronic inflammation and metabolic syndrome, as exemplified by the Western diet (Port et al., 2021). This kind of dietary intake is related to obesity and insulin resistance and further leads to chronic diseases like type 2 diabetes and cardiovascular conditions (Port et al., 2021). This impact of processed foods indicates the role of dietary composition in preventing chronic diseases.

Nutrient-Specific Contributions

Some of the nutrients have been known to help prevent chronic diseases. For example, dietary fiber is very essential in ensuring that the general health of the gut is well kept and has reduced the incidence of colorectal cancer and cardiovascular diseases, according to Camerotto et al. (2019). Diets that are high in fiber enhance satiety, weight management, and lipid profiles. Similarly, potassium-rich diets, typically obtained from fruits and vegetables, are marked with an intimate association with lower blood pressure, and hence, lower the risk of stroke (BernierJean et al., 2021). This, therefore, validates the fact that these nutrient groups have been added into regular diets.

Mediterranean Diet

The Mediterranean diet has also emerged to be among the most often cited models as regards chronic disease prevention, the basis of the diet being founded on whole foods, healthy fats, and relatively low levels of red and processed meats. It has been associated with decreased risks of cardiovascular diseases, various cancers, and neurodegenerative disorders (Mehmas, 2022). High contents of omega-3 fatty acids, antioxidants, and fiber make this diet a recommended approach for lowering the risk of chronic diseases in people (Cena & Calder, 2020).

Dietary Patterns and Inflammation

Most chronic diseases are founded on chronic inflammation. The DII has been created to determine the inflammatory level of dietary intakes. Shivappa et al. report that a diet that contains anti-inflammatory foods, which includes fruits, vegetables, and whole grains, tends to reduce the risk of developing chronic diseases and lowering inflammation. A diet that has high contents of refined carbohydrates and unhealthy fats would feed inflammatory processes that are more likely to increase the risk of diseases (Shivappa et al., 2013).

Education and Awareness

Nutrition education is one of the leading factors behind healthy food intake, thus possibly preventing chronic diseases. There exists evidence that people who are heath-observant and aware will likely adopt healthier eating practices (Snyder & Dougall, 2018). Also, it serves as a great tool against the health disparities that exist. In some populations, these people are inadequately exposed to nutritionally adequate diets, or they just do not know what healthy eating is (Chen et al., 2011). The public health program on nutrition education can empower a person to choose the right diets that help prevent chronic diseases.

Dietary Patterns Linked to Reduced Risk of Chronic Diseases

Mediterranean Diet

The Mediterranean diet is highly recognized for its health benefits and characterized by high consumption of fruits, vegetables, whole grains, legumes, nuts, and olive oil, moderate intake of fish and poultry, and low intake of red meat and sweets. Dinu et al. did an extensive review of the literature and con-

cluded that adherence to the Mediterranean diet is inversely associated with the risk of chronic diseases, including cardiovascular diseases, type 2 diabetes, and certain cancers (Dinu et al., 2017). The diet rich in antioxidants, healthy fats, and fiber contributes to its anti-inflammatory character, which is essential in countering the risk of chronic diseases (Dinu et al., 2017).

Moreover, there is evidence that the Mediterranean diet is associated with improvements in cognitive function and a reduction in neurodegenerative diseases. It has been established that people with such a diet have better cognitive function and reduced rates of Alzheimer's disease (Dinu et al., 2017). Anti-inflammatory action due to its rich polyphenol and omega-3 fatty acid content has been suggested as one of the possible mechanisms by which this protective outcome is observed (Dinu et al., 2017).

DASH Diet

The DASH diet was formulated to lower blood pressure and emphasizes intakes of fruits, vegetables, whole grains, and low-fat dairy products with less intake of saturated fats, red meat, and sweets. The DASH diet has been related to lower blood pressure and lower risk of cardiovascular diseases (Wang et al., 2014). The studies by Gutiérrez et al. suggested that a DASH-type diet has a significant influence on reducing one's chances of renal function decline and continued underpinning of the beneficial implications of DASH in regard to chronic disease (Gutiérrez et al., 2014).

The DASH diet focuses primarily on high nutrient intake. Therefore, it ensures healthy consumption of vital vitamins and minerals such as potassium, magnesium, and calcium that are significant for cardiovascular health (Wang et al., 2014). The diet has a high fiber intake, thereby helping manage weight and improving lipid profiles; hence its overall health benefits (Wang et al., 2014).

Prudent Dietary Pattern

The Prudent dietary pattern, characterized by the intake of fruits, vegetables, whole grains, and fish, has been associated with a reduced risk of chronic diseases, including cardiovascular disease and diabetes (Zadeh et al., 2020). Adherence to the Prudent dietary pattern is associated with reduced risks for non-alcoholic fatty liver disease (NAFLD) as well as a myriad of chronic conditions, said a systematic review and meta-analysis by Zadeh et al. (2020). Its main advantage regarding metabolic health revolves around the tendency to balance between taking appropriate amounts of macronutrients and their micronutrients in addition to limiting processed foods.

Plant-based Diets

Plant-based diets, an area of focus for health benefits because of preference to whole plant foods in place of minimizing or excluding animal products, show that the risk of suffering from chronic diseases such as type 2 diabetes and cardiovascular diseases is less in plant-based diets as compared to others (Jayedi et al., 2020). High fiber intake, antioxidants, and phytochemicals have been linked to plant foods, as these are correlated with improved metabolic health and less inflammation (Jayedi et al., 2020). A further number of studies have established that the risk of chronic diseases would be diminished substantially if the consumption of animal protein is substituted with plant-based protein sources (Mijatovic et al., 2018).

Other Dietary Patterns

Some other dietary patterns have also been found to be beneficial for the prevention of chronic diseases. AHEI, for example, was identified to be significantly related to reduced risks of hepatocellular carcinoma and other chronic diseases (George et al., 2021). Similarly, in a study by Zheng et al., they provided that there is an association between a Vegetable-Fruit dietary pattern and lower risks of heart diseases among the elderly, which indicates a potential importance of fruits and vegetables in chronic disease prevention (Zheng et al., 2023).

Role of Macronutrients and Micronutrients in Chronic Disease Prevention

Macronutrients

Carbohydrates

Carbohydrates are the most significant source of energy in the body and play an important role in metabolic health. The intake of different carbohydrates greatly affects chronic disease risk. Diets high in

whole grains, fruits, and vegetables-which contain much dietary fiber-have been associated with lower risks of cardiovascular diseases and type 2 diabetes (Jakobsen et al., 2010). Dietary fiber intake manages blood sugar, improves lipid profiles, and gives feelings of fullness that might be helpful in managing weight (Jakobsen et al., 2010). Diets that contain high intakes of refined carbohydrates and added sugars have been associated with increased risks of obesity, insulin resistance, and metabolic syndrome (Running & Mattes, 2016). Other nutrients are carbohydrates. Carbohydrates are measured using the glycemic index, with low glycemic index foods associated with improved regulation of blood sugar and lower chronic disease risks (Jakobsen et al., 2010).

Proteins

Proteins are required for growth, repair, and maintenance of body tissues. Proteins are also vital in the functioning of the immune system and hormone production. The source of protein is paramount; plant-based proteins like legumes and nuts are related to a reduced risk of chronic diseases compared to animal-based proteins, especially red and processed meats (Ganesan & Xu, 2017). High-protein diets can aid in weight loss and improve metabolic health, but excessive intake of animal proteins has been associated with increased risks of certain cancers and cardiovascular diseases (Ganesan & Xu, 2017). Furthermore, adequate protein intake is vital in the elderly for preserving muscle mass to prevent disability due to frailty and associated chronic diseases (Ganesan & Xu, 2017).

Fat

Fats are part of a healthy diet because they help provide the essential fatty acids and facilitate the absorption of fat-soluble vitamins A, D, E, and K. The amount and nature of fat have a significant bearing; unsaturated fats, the omega-3 fatty acids being those from fish, flaxseeds, and walnuts, reduce the inflammation and risks associated with heart diseases (Jakobsen et al., 2010). Higher levels of trans fats and saturated fats indicate higher levels of LDL cholesterol as well as an increased risk to cardiovascular diseases (Jakobsen et al., 2010). Omega-3 to omega-6 fatty acid balance is also important in maintaining cardiovascular health and reducing chronic inflammation (Jakobsen et al., 2010).

Micronutrients

Vitamins

Vitamins have great roles in the preservation of health and prevention of chronic diseases. For instance, vitamin D is a crucial nutrient that ensures the proper functioning of the immune system and good bone health, and deficiency is correlated with a high risk of chronic diseases such as osteoporosis and specific cancers (Ati-Hellal & Hellal, 2022). For instance, antioxidant vitamins such as vitamins C and E can counteract oxidative stress, an action implicated in chronic diseases. B vitamins function in energy metabolism and are correlated with reduced chances of cardiovascular disorders and cognitive decline (Ati-Hellal & Hellal, 2022).

Minerals

The minerals are essential in many physiological processes, including the maintenance of health of bones, fluid balance, and muscle contractility. Calcium and magnesium help maintain the bone density to avoid osteoporosis in old people (Ratajczak et al., 2020; Miranda-Bautista et al., 2019). Iron plays an important role in oxygen transportation and energy generation; its deficiency causes anemia, which presents symptoms of weakness and poor quality of life (Muros et al., 2019). Zinc is important for immune function, and adequate intake will prevent chronic diseases associated with immune dysfunction (Muros et al., 2019). The role of minerals and their interplay in chronic conditions is better illustrated by chronic kidney disease, where mineral imbalances enable advancing health conditions (Chartsrisak et al., 2013; Waziri et al., 2019).

Intensity of Physical Activity

Moderate-Intensity Exercise

Moderate intensity exercises are the ones with brisk walking and cycling, and so on. The Centers for Disease Control and Prevention established that doing at least 150 minutes of moderate-intensity activity in a week will help reduce the risks of chronic diseases (Shiroma et al., 2014; Samitz et al., 2011).

Most of the individuals can easily do moderate-intensity activities with minimal risks and adapt it in their day-to-day life.

Vigorous-Intensity Physical Activity

Vigorous-intensity activities, like running and high-intensity cycling give more health benefits but for fewer periods than needed for moderate-intensity activities. This can be done at least 75 minutes a week (Shiroma et al., 2014; Samitz et al., 2011). Actual studies reveal that those who have vigorous-intensity exercise seem to lose more body weight while showing better cardiovascular health than moderates who have moderate-intensity exercise (Shiroma et al., 2014; Samitz et al., 2011).

Prevention of Sedentary Behaviours

The curbing of diseases of chronic lifestyle also requires lowering sedentary behaviors. Such sedentary behaviors lead to obesity, diabetes type 2, and some cardiovascular diseases among many others when a person engages in long sittings and even inactivity in general (Tama & Astutik, 2022; Alves et al., 2016). Some offsets for the wrong effects of the sedentary behaviors include undertaking regular bouts of physical activity dispersed within one's daily activities-which may sometimes include standing and walking breaks-in general (Tama & Astutik, 2022; Alves et al., 2016).

Interactions Between Diet and Physical Activity

Interaction Between Diet and Physical Activity in Chronic Disease Prevention

Synergistic Effects on Metabolic Health

Diet and exercise balance each other concerning their combined contribution to metabolic wellbeing. For example, a given individual who exerts loses some energy, while the muscles then become more responsive to insulin facilitating better glucose metabolisms. Once diet has evened out through combining fruits, vegetables, whole grains, and lean proteins, such exercise effects heighten their potential strengths for improvement in metabolic health. For instance, Liu demonstrates how diet and physical activity have direct positive associations with metabolic health such that the ideal outcome is seen when both aspects are combined together (Liu, 2024). Dietary balance will furnish the nutrients, which will subsequently help in the physiological adaptations seen during exercise such that metabolic health will be promoted, and all risks of diseases such as type 2 diabetes and cardiovascular conditions will be avoided (Liu, 2024).

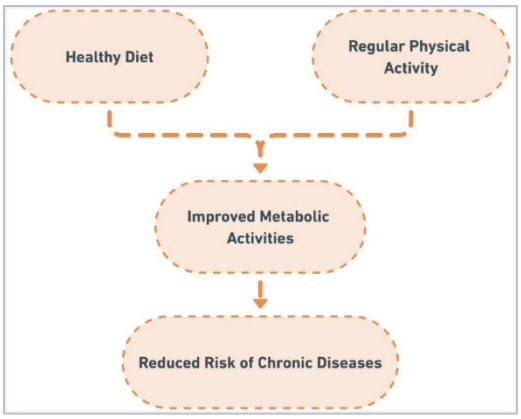
Inflammation and Immune Function

The major underlying factor in most of the chronic conditions is chronic inflammation. Diet and exercise play significant roles in modulating inflammation. Reduced pro-inflammatory cytokine levels along with increased levels of anti-inflammatory cytokines reduces the burden caused by chronic physical activity (Zouhal et al., 2022). Inflammation may further be reduced through a diet that is rich in antioxidants, like vitamins C and E, as well as omega-3 fatty acids (Olza et al., 2017). The healthy diet in combination with the regular exercise will lead to improved immune function as well as reduce the risk of chronic diseases linked to inflammation (Zouhal et al., 2022).

Weight Management and Body Composition

Proper weight maintenance forms an integral condition for preventing the disease conditions, so diet and regular physical activity become components of the effective plans in weight loss. Physical exercise facilitates burning fat as well as forming body lean muscles to enhance the metabolic activities in your body. It increases the burning and further reduction of excess fat in the body (Anderson & Durstine, 2019). A diet rich in nutrient-dense foods and low in processed foods and added sugars has been shown to support weight control and reduced obesity-related chronic disease risk (Boeing et al., 2012). Interactions between diet and exercise also play a particularly important role in achieving and maintaining a healthy body composition, which remains a key risk factor for chronic diseases (Anderson & Durstine, 2019).

Figure 1. The synergistic relationship between a healthy diet and regular physical activity in reducing the risk of chronic diseases. Adapted from Anderson & Durstine, 2019 and Boeing et al., 2012.



Nutrient Absorption and Utilization

This can influence how the body will react to exercise since it affects the absorption and utilization. For instance, protein ingestion ensures that after any form of exercise, the muscles will be repaired or built. The time and quality of ingested protein have been reported to improve recovery and performance (Samuel et al., 2020). There are other micronutrients known as vitamins and minerals, which play a supportive role in energy metabolism and muscle function. According to Olza et al., a well-balanced diet is associated with enhanced redox status that has a positive effect on the body's capability to cope with oxidative stress under physical activity (Olza et al., 2017). This interaction explains why nutrient intake is important for physiological demands under exercise.

Psychological and Behavioral Factors

Interactions between diet and exercise also include psychological and behavioral factors. Another factor would include physical activity that has a direct and positive effect on mood and can reduce stress which in turn leads to healthier diets. Healthy diets may also increase energy and motivational levels to partake in the appropriate amounts of physical activity (Samuel et al., 2020). In the present scenario, it is unidirectional and therefore lifestyle interventions need not focus on diet alone or exercise alone to be effective finally in chronic disease management. Only when health education programs will stress on benefits from both sides, such as the advantage of a healthy diet as well as frequent exercise, can an individual become knowledgeable and better for his/her decision towards good health (Alzaben, 2023).

Long-term health advantages

Regular exercise, in addition to healthy nutrition, confers numerous well-known health benefits for the long term. In a systematic review, Reiner et al. found that regular physical activity is associated with the prevention of most chronic diseases, including cardiovascular diseases, type 2 diabetes, and several types of cancers (Reiner et al., 2013). In addition, it is said in the review that an active lifestyle combined with healthy dieting has healthier outcomes and reduces the rate of mortality compared to individuals who are not engaging in an active lifestyle (Reiner et al., 2013).

Socioeconomic and Environmental Factors

Influence of Socioeconomic Factors on Diet, Physical Activity, and Chronic Disease Outcomes

Socioeconomic Status and Diet

The most determining factor in diet and nutrition is the socioeconomic status of the person. Poor individuals rarely consume fresh vegetables, fruits, or dairy products and may easily turn into fast-food and soft-drink consumption patterns. This study by Bonaccio et al. concluded that low income goes along with poor adherence to a Mediterranean diet and a higher prevalence of obesity, thus linking socioeconomic disparities as contributors to diet-related chronic diseases (Bonaccio et al., 2012). Higher-quality diets, mainly those that are rich in fruits, vegetables, and whole grains, tend to be consumed by individuals with greater education and higher income (Bonaccio et al., 2012). This difference

in diet quality can partially explain the higher cardiovascular disease risk profiles observed among low SES groups (Bonaccio et al., 2012).

Healthy foods are too expensive for low-income families, who have no choice but to spend their money on cheaper, nutrient-poor foods that are high in sugars and unhealthy fats. Novak et al. also sustain this by affirming that healthier Mediterranean products, which are often more expensive than the staple of the Western diet, are not accessible for poor classes (Novak et al., 2017). Consequently, these dietary patterns trigger the emergence of obesity, diabetes, and other chronic diseases.

Influence of Socioeconomic Status on Physical Activity

Socioeconomic status also decides levels of physical activity. In individuals from more disadvantaged socioeconomic backgrounds, opportunities to participate in accessible and safe settings for recreation venues, organized sport, or other exercise facilities could be limited that may further curtail participation to regular levels of physical activity (Stalsberg & Pedersen, 2010). In a study on leisure-time physical activity prevalence differences between various categories of socioeconomic levels, Andrade et al found that the individuals belonging to the lower SES level participated much less in activities than their counter parts (Andrade et al., 2015). This gap may increase the risks of obesity and other chronic diseases.

Low SES related psychological factors like higher stress and anxiety levels discourage the involvement in the physical activities. Falese et al. further stated that poor socioeconomic conditions have been associated with higher levels of stress, anxiety, and depression, which will deter adolescents from indulging in the practice of physical activities (Falese et al., 2021). Jiao et al. stated that the greater the socioeconomic status, the further apart the gaps are between boys and girls on physical activity levels, meaning that more socioeconomic influence falls on the shoulders of men compared to women (Jiao et al., 2023). This means that the intervention for physical activity needs to incorporate the socioeconomic background for effectiveness.

Diet-Physical Activity Interplay

There is interplay between diet and physical activity and also on how it cuts across socioeconomic backgrounds. The healthy behaviors of dietary consumption and physical activity are also mutually reinforcing; persons with high SES are more likely to exhibit these combined behaviors than their counterparts. Brown et al. found that the physical activity levels and lipid biomarkers for cardiovascular disease risk are mediated by socioeconomic status; hence, in neighborhoods with a lower socioeconomic level, people have fewer opportunities to be physically active, thus contributing to widening health inequalities (Brown et al., 2016).

This is in contrast to healthy diets, which can provide positive feedback by increasing energy levels and motivating the person to increase their physical activity and thereby improve health results even more. This interaction underscores the need for considering both dietary habits and physical activity in the approach of public health interventions in reducing the risk of chronic diseases.

Chronic disease outcomes

Socioeconomic factors have a great influence on the effects of diet and physical activity combined in determining chronic disease outcomes. Individuals with a low socioeconomic background are likely to experience chronic diseases due to poor dietary habits and low levels of physical activity (Ji et al., 2013). Mendez et al. further found that in children, social economic status interacts with obesity based on a conceptual model mediating physical activity status and weight status (Mendez et al., 2023). Therefore, enhancing accessibility and availability of wholesome foods along with physical activities, the chronic risks could be well prevented in any disadvantaged groups.

Additionally, the prevalence of metabolic syndrome and its related factors, such as obesity and hypertension, is generally more common among people with a low SES; hence, there might be a need for targeted intervention for such persons (Moreira et al., 2014). Public health interventions will only be effective if the root determinants of social health are addressed. The most common of them is SES.

Public Health Implications

The socio-economic influences of diet, exercise, and consequences of chronic disease, in understanding them, hold valuable position importance in the public health policy. Socio-economic considerations, therefore, shall be made regarding the interventions which are proposed to be employed in bringing about a change to better dietary practice and more considerable exercise. Programs that easily provide healthy low-cost food and outdoor safe environments will improve the healthier lifestyles of the poor population (Hu et al., 2011; Stalsberg & Pedersen, 2010). In addition, nutrition and physical activity education programs can provide people with knowledge to make healthy choices regardless of their socioeconomic status (Alzaben, 2023).

Influence of the Built Environment on Promoting Healthy Behaviors

Urban Design and Walkability

Urban design, particularly walkability, has a fundamental effect on physical activity in cities. It refers to neighborhoods that contain sidewalks, which are pedestrian-friendly and allow easy access to amenities to encourage the residents to walk, among other physical activities. Sidewalk availability, and accessibility of these destinations to amenities such as recreations, according to Tsuda et al, are positively linked to physical activities among older people Tsuda et al. 2012). Frank et al. further found that mixed land use and foot-friendly neighborhoods enable active living alongside the reduction rate of obesity level (Frank et al., 2022). These discoveries support an urban planning of environments that have to be planned in order to sustain activities such as physical activity.

Recreation Facility Access

Parks, gyms, and other facilities for recreation purposes have to be developed to inspire people to take up physical activities and maintain health. It is found that the chances of regular physical activity can be observed in a student if he or she resides close to recreation facilities (Roubal et al., 2015). The Sato et al demonstrated that the use of parks and facility utilization is indeed associated with having more physical activities, and these are likely an important route also towards healthier living lifestyles among other elderly adults too (Sato et al. 2019). Shared-use agreements also expand the capacity for physical activity among children and families in low-resource communities because schools or faith-based facilities are made available for use by the community (Hardison-Moody et al., 2017).

Socioeconomic Factors

The socioeconomic factors interact with the built environment in creating health behaviors. Low-income areas hardly have health food stores and safe areas for recreation, thereby having a high rate of obesity and chronic diseases related to obesity (Azeez et al., 2023). The design of the built environment, as put forward by Azeez et al., either promotes or constrains health behavior, most specifically among the economically more disadvantaged population (Azeez et al., 2023). This would help decrease inequities in the built environment, which would better the health equity and prevent chronic diseases.

Food Habits

The built environment impacts the physical activity but also has an impact on food habits. The availability of grocery stores, which are providing fresh produce and healthy food, builds up the desire to eat healthily. Studies argue that the more supermarkets and farmers' markets in a region, the better-quality diets and reduced obesity prevalence (Sibbald et al., 2015). Food deserts are places that lack convenient and affordable access to healthy and affordable food, which in turn, lead to poor diet and chronic diseases risks (Sibbald et al., 2015). This can be the underlying reason designing urban space may facilitate or hinder the healthy food product consumptions of its population and thereby diets.

Psychological and Social Factors

Built environment impacts psychological and social determinants of health behaviors. Attractive environments and safe perceptions increase motivation in both physical activity and healthy eating as well-known (Travert et al., 2019). Yen et al. observed some elements of the physical environment-such as safety and litter levels-and manipulated and modified affective motivation and self-efficacy with regard to PA (Travert et al., 2019). Community-based social contexts also influence physical activity and

healthy eating, partly by encouraging social integration and participation in joint activities (Sibbald et al., 2015).

Long-term Health Outcomes

Such implications therefore pose a tremendous risk to the long-term health outcomes of people due to the cumulative effects the built environment creates on physical activities and dietary behaviors. According to research, the populations living in friendly environments for active living exhibit minimal tendencies towards such diseases as obesity, diabetes, or cardiovascular diseases (Pinter-Wollman et al., 2018). Such health-promoting features can then be integrated into the design of an urban area, thereby contributing a lot to public health and, by default, lower health costs and quality of life (Sato et al., 2019; Philbrook & El-Sheikh, 2016).

Policy and Public Health Interventions

Effective Public Health Strategies for Promoting Healthy Diets and Physical Activity

Community interventions

Community-based interventions are proved to promote healthy diets and physical activity. An example of the same is "Healthy Body Healthy Spirit," that has combined nutrition education with a focus on increasing levels of physical activity among the participants. Positive changes in the diet practice are noted to occur with such intervention Bopp et al. 2012. These interventions usually work with the local organizations and stakeholders to work towards developing supportive environments that make healthier food options accessible and provide avenues for opportunities in physical activities.

In addition, school-based physical activity interventions enhance young people's awareness regarding active lifestyles. According to a meta-analysis by Love et al., the outcomes indicated that school-based interventions significantly enhanced the physical activity levels and health benefits amongst children, which were mostly for deprived groups (Love et al., 2019). The result indicates that the schools should become the main point of intervention targeting health promotion.

Digital Health Interventions

Digital health interventions are now proven effective in fostering increased physical activity and healthy eating behavior. An article by Santis et al. demonstrated how digital interventions help health promotion and prevention of disease in children and adolescents (Santis et al., 2022). Such intervention offers self-reported feedback on the personalized features of the app, as well as features in setting one's goals for behaviors to change and social support. Another is smartphone apps that promote the use of one's body through physical activity show promising effects. Romeo et al. did a systematic review and found that the app-based intervention was effective for promoting an increase in physical activity, especially with the integration of other behavioral change interventions (Romeo et al., 2019). Because of flexibility and easy accessibility, digital technologies are important in promoting healthy lifestyles among diverse population groups.

Workplace Health Promotion Programs

Work-site health promotion programs are today generally used as incentives for a proper diet and physical exercise. Mache et al. proved that interventions within the workplace in relation to the improvement of physical activity can lead to a substantial gain in health for overweight workers (Mache et al., 2015). Such programs commonly include challenges such as fitness, health screenings, and exercise facilities that make it easy to promote healthy behavior. Moreover, financial incentives and social network incentives have been found to boost participation in work site health promotion programs. It has been demonstrated that even little financial rewards could be effective in enhancing the level of physical activity among elderly adults by Yamashita et al (2021).

Policy and Environmental Changes

Environmental change promoted by public health policies can also promote healthy behavior. When planning for cities becomes more effective in devising walkable neighborhoods and better access to park and other leisure facilities, physical activity increases (Tsunoda et al., 2012; Frank et al., 2022). Such changes enhance the access of healthy foods and, therefore, support healthy dietary behaviors. Policies that limit access to unhealthy foods in schools and communities have been proven to improve

diet behaviors. Regulation of food advertising to children and healthy food environments can also lead adolescents into developing healthier eating patterns (Sibbald et al., 2015).

Educational Campaigns

Behavioral changes could only be achieved through education on healthy diets and exercise. Nutrition education programs through cooking classes have been shown affecting diet among varied groups, and this includes even low-income earner groups as well (Sanavi et al., 2021). Education empowers individuals with the necessary skills and information on the appropriate selection of food. At the same time, public health campaigns advocating for the positive impacts of exercise can inspire people to adopt healthy lifestyles. In such cases, such campaigns are successful when the communities become involved and support them (Alzaben, 2023).

Role of Macronutrients and Micronutrients in Chronic Disease Prevention

Government Policies and Programmes

Governments have been very essential in establishing policies and regulations that promote public health and reduce chronic diseases. Some of the successful government policies include laws and regulations that help in creating a healthy environment. For instance, Mitchell et al. outlines how local governments in the UK employed legal approaches to curb obesity by planning the cities and regulating the food environment Mitchell et al. (2011). Some of these policies are zoning laws, for example, which promote the establishment of parks and other recreational facilities and laws on the advertising of foods, especially to children. In addition, governments can invest in public health campaigns to raise awareness about healthy eating and physical activity. The campaigns may target populations at higher risk for chronic diseases, ensuring that health messages are culturally relevant and accessible. For example, the World Health Organization has developed strategies for reducing mortality from chronic non-communicable diseases. The inter-sectoral collaboration between health, education, and governance sectors is key in the process (Bernardes et al., 2020).

Healthcare Systems

The role of health care systems in the prevention and management of chronic diseases is providing preventive care, screening, and education. Appropriate preventive measures are initiated only through the identification of people at risk by primary care providers. An example is the Australian government launching 75+ Health Assessment, which focuses on the preventive care of older adults targeting the identification of health needs among the aged population to help in preventing further health problems in the future (Carey et al., 2021). The health care systems also offer avenues to make the available resources and programs accessible to facilitate healthy behavior. For instance, lifestyle interventions implemented as part of chronic disease management services, including nutritional counseling and physical activity encouragement, have been related to improved health outcomes for patients with already existing chronic conditions (Dona et al., 2021). Healthcare professionals can work with community agencies to design referral programs that will connect patients to community resources, such as exercise classes and nutrition workshops (Vachon et al., 2020).

Community Agencies

Community-based groups are a high priority for support of healthy living behaviors. They normally act as middlemen between individuals and the resources available in their community. Community-based interventions, such as access to healthy foods and opportunities for physical activity, have been proven effective in health outcomes. For example, community gardens and farmers' markets may increase access to fresh produce in underserved areas, thus encouraging healthier eating behaviors ("Call for papers: Social Prescribing in Canada", 2023). Another area through which community organizations can provide support is through social prescribing, whereby people relate to non-clinical support services such as exercise classes, cooking workshops, and mental health sources. This will provide the individual with power to care for their health and well-being, bringing them a sense of community and support that leads to behavior change over the long term ("Call for papers: Social Prescribing in Canada", 2023).

Partnership

Good public health practice entails multilateral collaboration between sectors and maximizes each sector's potential. For instance, the execution of health promotion within urban planning creates environments to facilitate physical activity and healthy eating. Cooperation between government, health care systems, and community organizations is important in the production of comprehensive prevention strategies for chronic diseases. The policies and plans developed in these aspects can also empower healthcare providers to educate patients on how to utilize the environments developed (Politis et al., 2014). On a larger scale, intervention for social determinants of health, like socioeconomic status and availability of resources, significantly affects the health inequities identified within the population. Projects aimed at improving the built environment and encouraging higher use of recreational space as well as introducing healthy food outlets are influential factors that could potentially affect the rate of prevalence of chronic diseases among the most vulnerable groups (Hu et al., 2011).

Future Directions

Research Gaps and Future Directions in Chronic Disease Prevention

Built Environment and Health Outcomes

Although literature on the built environment and health outcomes is ever-increasing, there are many gaps in knowing the specific design characteristics that can promote healthy behaviors. Rollings and Bollo note that cohort studies are required to examine how the various built environment factors impact mental health outcomes and chronic disease risk Rollings & Bollo (2021).

Translation of Research to Practice

One notable gap that can be highlighted is the translation of research findings into practice to prevent chronic diseases. Liu et al. talk about the translation of evidence-based interventions into practice and implementation in the prevention programs for chronic diseases. Indeed, future work should include effective strategies regarding the translation of research into the real world - identification of possible barriers to effective implementation and their frameworks to embrace evidence-based practices in the applied settings (2022 Liu et al.).

Health Literacy and Chronic Disease Management

Very limited studies have been done on health literacy concerning the management of chronic diseases. According to Nock et al., it is true that there is a need to identify how health literacy influences the patients' ability to effectively manage their chronic conditions (Nock et al., 2023). Further research into the capability of health literacy in preventing chronic diseases should be directed to identify ways in which education intervention can effectively provide patients with abilities to make appropriate decisions regarding their health and implement self-management practices.

Digital Health Interventions

The rapid rise of digital health technologies offers opportunities and challenges for the prevention of chronic diseases. According to Raeside, by 2024, technology will have increased engagement with health promotion because many digital health programs have not changed the risk factors related to chronic diseases (Raeside, 2024). Future studies should include effectiveness in the populations receiving these digital health interventions through indicating the best practices implemented in the inclusion of technologies on schools, and health facilities or other locations

Community Engagement and Clinical Linkages

Effective chronic disease prevention requires integration between community organizations and clinical services. Al-Murani et al. stress the importance of CCLs in chronic disease management, yet further studies are still required to explain how such linkages may be optimized (Al-Murani et al., 2019). The processes whereby CCLs could enhance better health outcomes, together with proposals of how to engage in collaboration from the community organizations' perspective and providers should be put forth in research endeavors.

Socioeconomic Status Disparity

The performance regarding chronic illnesses as well as the health-related practices are deeply rooted in issues pertaining to economic conditions. However, there is scarce research that has explored the relationship between socioeconomic status, health behaviors, and chronic disease risk. According to Gauthier-Beaupré et al., to create interventions that are targeted, there is a need to understand how the socioeconomic disparities influence access to resources and health outcomes (Gauthier-Beaupré et al., 2023). It will then become necessary in the research process to clearly indicate the strategies that have been effective for addressing such disparities and advancing health equity in chronic disease prevention.

Longitudinal Lifestyle Interventions

Though evidence exists showing lifestyle interventions prevent chronic diseases, very few longitudinal studies have followed patients to ascertain whether the lifestyle intervention is maintained. Leong et al. underscore the fact that longitudinal studies are needed to examine the long-term effects of chronic disease self-management programs (Leong et al., 2020). Future research should explore those factors that might make healthy behaviors sustained over time, as well as the role that continued support can play in keeping lifestyle changes effective.

Collaborative Strategies Among Individuals, Healthcare Providers, and Policymakers to Reduce Chronic Disease Burden

Enabling Individuals

Individuals need to take care of their health and prevent chronic diseases through lifestyles. Education and awareness are at the core of enabling individuals to make the right choices regarding diets and physical activity. Community-based programs that provide nutrition education, cooking classes, and physical activity workshops can improve knowledge and skills and promote healthier behavior (Duda-Sikuła & Kurpas, 2023). In addition, the involvement of family and social support in health care can increase adherence to lifestyle changes. Feng et al. propose that engaging family and friends in health interventions can help enhance the efficacy of chronic disease management because social support is an important factor for promoting healthy behaviors (Feng et al., 2016). Encouraging people to be more active in managing their health creates a sense of ownership and responsibility that is essential for long-term behavioral change.

Healthcare Providers as Facilitators

Healthcare providers are instrumental in chronic disease prevention through their direct interactions with patients. They can offer personalized advice, conduct regular screenings, and provide referrals to community resources that support healthy behaviors. Luquis and Paz emphasize the importance of primary care providers in identifying patients at risk for chronic diseases and referring them to appropriate interventions (Luquis & Paz, 2014). Further, health care providers can use a person-centered approach that takes into account the social determinants of health. This will involve understanding the context in which the individual lives, including his or her socioeconomic status and availability of resources that may impact the ability to make healthy choices. Megari suggests that these factors need to be addressed to enhance the quality of life for patients with chronic diseases (Megari, 2013). With this understanding, healthcare providers can focus their interventions on the needs of their patients.

Policymakers and System-Level Changes

Policymakers will play a vital role in ensuring that the right environments for healthy behaviors are promoted. Effective public health policies should provide easy access to healthy food, safe playgrounds, and other services. According to Knai et al., "Political will and commitment will be required to make chronic care happen, including providing sustainable funding for disease prevention and health promotion interventions" (Knai et al., 2014). Policies that regulate food marketing, particularly to children, and those that promote the availability of healthy food options in schools and communities, can have an impact on diet. This will be a walkable neighborhood and access to parks, which promotes more walking. Diversely, there's health promotion from the educational sectors, transport, housing, etcetera for bringing in holistic ways of chronic disease prevention to completeness (Slivšek, 2024).

Community Engagement and Cooperative Effort

This is going to be a cooperative effort among the individual, health provider and a policymaker that helps in curbing these chronic diseases. Community-based organizations can act as an intermediary between the individual and the healthcare provider or policymaker. As cited by Duda-Sikuła and Kurpas, the necessary activity of community leadership is with stakeholders who direct them in planning and implementing health promotion interventions (Duda-Sikuła & Kurpas, 2023). It aligns community engagement with practicality and effectiveness within the intervention as it should culturally respond to the needs of the targeted population. In fact, for example, offered services can come into existence by linking the entire community through a chronic disease control process by health workers in communities (Knai et al., 2013).

Research and Evaluation

Continuous research and evaluation will result in determining intervention effectiveness and to be able to direct future strategies. The policymakers should, therefore, provide funding for research that examines the impact of different health promotion initiatives on chronic disease outcomes. Ogedegbe et al. emphasize the need to evaluate task-shifting interventions for chronic disease management in informing best practices for resource allocation in healthcare systems (Ogedegbe et al., 2014).

Besides, it would be important to identify the factors hindering effective implementation of interventions for the design of strategies applicable to different settings. Research studies need to explore ways to achieve better engagement by people, providers of health care, and the communities in efforts for chronic disease prevention (Knai et al., 2013).

Conclusions

The rising tide of chronic diseases presents a dramatic challenge to health systems, economies, and societies worldwide. Now is a good time to recall that answers to these problems need to be broad-based in scope-impacting at the level of individual behavior, socioeconomic inequities, and environmental determinants. At the heart of prevention and management, of course, are balanced diets and regular physical activity, but these alone do not go far enough. Integrate emerging technologies such as mobile health applications and evidence-based practices such as social prescribing into prevention strategies to enhance the quality of such interventions. Eradicate systemic barriers such as food deserts, unsafe urban environments, and health disparities in low-resource settings for the creation of equitable health outcomes. Interventions must be designed by policymakers that foster sustainable behaviors, reduce healthcare costs, and improve quality of life. Future research priorities should include longitudinal sustainability of lifestyle interventions, further investigation into health literacy as it relates to managing chronic diseases, and the elaboration of tailor-made strategies aimed at vulnerable groups. By a collaborative and proactive approach.

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