Journal of Advanced Biomedical Sciences

Journal of Advanced Biomedical Sciences
https://jabs.fums.ac.ir/
Online ISSN: 2783-1523

Fasa University of Medical Sciences

# Lifestyle Medicine and Preventive Strategies for Chronic Diseases: A Narrative Review

**Armin Alizadeh Shirazi Nezhad[1], Amirali Ebrahimbabaei[2,3]**

1. School of Public Health, University of Saskatchewan, Saskatoon, Canada
2. Student Research Committee, Fasa University of Medical Sciences, Fasa, Iran
3. Department of Physiology, Fasa University of Medical Sciences, Fasa, Iran

## Article Info

**Article Type:**
Review Article

**Article history:**
Received
02 Dec 2025
Received in revised form
02 Feb 2026
Accepted
08 Feb 2026
Published online
10 Mar 2026

**Publisher**
Fasa University of Medical Sciences

## Abstract

**Background & Objectives:** Noncommunicable diseases (NCDs) remain the leading cause of morbidity and mortality worldwide and are driven predominantly by modifiable lifestyle-related factors. In recent years, lifestyle medicine has emerged as a distinct clinical discipline and academic field at many leading universities, employing evidence-based lifestyle interventions to prevent, treat, and, in some cases, reverse chronic disease. This review examines the role of lifestyle medicine in the prevention and management of NCDs.

**Material & Methods:** A narrative review was conducted using PubMed, Scopus, and Google Scholar to identify relevant literature published between 2000 and 2025. More than 130 studies, clinical guidelines, and position statements addressing lifestyle interventions, NCD outcomes, and implementation strategies were reviewed. Priority was given to systematic reviews, meta-analyses, randomized controlled trials, and large prospective cohort studies evaluating the six core pillars of lifestyle medicine and their implementation in clinical practice and public health settings.

**Results:** Evidence across diverse study designs consistently demonstrates that whole-food, plant-predominant dietary patterns, regular physical activity, smoking cessation, reduced harmful alcohol consumption, restorative sleep, effective stress-management strategies, and strong social relationships are associated with a lower incidence and slower progression of major NCDs, as well as improved quality of life. Emerging evidence further supports the integration of lifestyle medicine into primary care, community-based interventions, and health-professional education.

**Conclusion:** Current evidence supports lifestyle medicine as an effective and comprehensive framework for addressing the behavioral determinants of NCDs. As the field continues to expand clinically and academically, integrating lifestyle medicine principles into healthcare delivery systems and professional training programs may substantially strengthen the prevention and long-term management of chronic diseases.

**Keywords:** Lifestyle Medicine, Noncommunicable Diseases, Chronic Disease, Diet, Exercise

**Cite this article:** Alizadeh Shirazi Nezhad A, Ebrahimbabaei A. Lifestyle Medicine and Preventive Strategies for Chronic Diseases: A Narrative Review. J Adv Biomed Sci. 2026; 16(2): 114-133.
**DOI:** 10.18502/jabs.v16i2.20876

## Introduction

Noncommunicable diseases (NCDs), particularly cardiovascular diseases (CVDs), cancer, chronic respiratory diseases, and diabetes, constitute one of the most significant public health challenges worldwide and account for a substantial proportion of global mortality and disability each year (1). Beyond their impact on mortality, NCDs impose considerable economic burdens through reduced productivity, escalating healthcare

**Corresponding Author: Amirali Ebrahimbabaei,** Student Research Committee, Fasa University of Medical Sciences, Fasa, Iran.
**Email:** a.ebrahimbabaei@fums.ac.ir

CC BY NC

expenditures, and increased pressure on healthcare systems, thereby exacerbating global health inequalities (2). These conditions are driven largely by modifiable risk factors, including tobacco use, unhealthy dietary patterns, physical inactivity, harmful alcohol consumption, and other adverse lifestyle behaviors (3). Consequently, major clinical guidelines increasingly recommend lifestyle modification as a first-line therapeutic strategy for conditions such as hypertension, diabetes, cardiovascular disease, and obesity (4). A central aspect of NCD epidemiology involves understanding the contribution of modifiable behavioral and environmental risk factors. The World Health Organization (WHO) identifies tobacco use, including exposure to secondhand smoke, physical inactivity, unhealthy diets rich in salt, sugar, and unhealthy fats, harmful alcohol consumption, and air pollution as major contributors to the global burden of NCDs. Furthermore, metabolic risk factors such as hypertension, overweight and obesity, hyperglycemia, and dyslipidemia substantially amplify these risks (5, 6). Lifestyle medicine is an evidence-based medical specialty that employs therapeutic lifestyle interventions as a primary modality for preventing, managing, and, in certain cases, reversing chronic diseases, including cardiovascular disease, type 2 diabetes, and obesity (7). The field emphasizes the modification of dietary habits, physical activity, sleep, stress management, substance use, and social relationships as central components of patient care (8). Over the past two decades, lifestyle medicine has evolved into a formal academic and clinical discipline, with dedicated curricula, certification pathways, and specialized educational programs established at leading medical schools and universities across North America and Europe (9-11). This rapid academic expansion reflects growing recognition that lifestyle-related determinants lie at the core of both the prevention and treatment of NCDs (12).

Compelling evidence suggests that a substantial proportion of NCDs and premature deaths associated with these conditions can be prevented through targeted lifestyle interventions (13). Clinical trials and systematic reviews have demonstrated, for example, that lifestyle interventions may reduce the incidence of type 2 diabetes by up to 58%, lower blood pressure to levels comparable with pharmacological therapy, and decrease cardiovascular events through improvements in lipid profiles and endothelial function (14-17). These findings align with broader public health trends, particularly those highlighted during and after the COVID-19 pandemic, which underscored the importance of resilience-building strategies in reducing vulnerability to chronic disease.

In practice, lifestyle medicine represents an evidence-based clinical framework that addresses the root causes of disease through sustained behavioral modification. The discipline is structured around six principal pillars of health (9, 18). These pillars consist of:

- **Whole-food, plant-predominant diet:** Emphasizing fruits, vegetables, whole grains, legumes, nuts, seeds, and minimally processed foods.
- **Physical activity**: Engaging in at least 150 minutes of moderate-intensity exercise per week, in accordance with WHO recommendations.
- **Stress management:** Applying evidence-based strategies such as mindfulness, relaxation techniques, and behavioral interventions to mitigate chronic stress and improve psychological well-being.
- **Adequate sleep:** Achieving approximately 7 to 9 hours of high-quality sleep per night to support metabolic, cognitive, and immune function.
- **Social connection:** Promoting supportive interpersonal relationships and active engagement in community and social activities.
- **Avoiding risky substances:** Eliminating

tobacco use, limiting alcohol consumption, and minimizing exposure to harmful environmental toxins and excessive ultraviolet radiation.

Lifestyle medicine therefore encompasses evidence-based behavioral interventions centered on nutrition, exercise, sleep, stress reduction, avoidance of harmful substances such as tobacco and excessive alcohol, and the cultivation of positive social relationships. These interventions function either as primary therapies or as adjunctive approaches in the prevention and management of chronic disease. Importantly, each pillar is supported by extensive clinical and epidemiological evidence, including findings from intensive lifestyle intervention studies demonstrating the prevention, remission, or substantial improvement of NCDs, particularly type 2 diabetes and coronary artery disease (4, 14). The COVID-19 pandemic further emphasized the critical role of lifestyle-related NCDs, as individuals with obesity, hypertension, diabetes, and cardiovascular disease experienced disproportionately poorer clinical outcomes (19). Consequently, the adoption of preventive lifestyle practices has become increasingly recognized as essential for improving population health and extending life expectancy globally (20). Table 1 summarizes the major pillars of lifestyle medicine, key NCD risk factors, and the corresponding lifestyle-based interventions.

Integrating lifestyle medicine into healthcare systems offers a cost-effective complement to conventional medical treatment while promoting patient empowerment and multidisciplinary collaboration. Landmark studies, including the Diabetes Prevention Program and the PREMIER trial, have demonstrated that combined dietary and physical activity interventions can produce sustained improvements in metabolic health, frequently yielding outcomes comparable to or exceeding those achieved through medication alone (21, 22). Nevertheless, several barriers continue to limit widespread implementation, including challenges related to long-term behavior change, insufficient provider training, and difficulties integrating lifestyle medicine

**Table 1.** Key Modifiable Pillars of Health, Risk Factors for NCDs, and Related Lifestyle Interventions.

| Lifestyle Pillar | Associated NCDs | Evidence-Based Interventions | Potential Impact | References |
|---|---|---|---|---|
| Nutrition | CVD, diabetes, obesity, cancer | Whole-food, plant-predominant diets (e.g., Mediterranean, DASH) are high in fiber and whole grains. | Linked to lower all-cause, cardiovascular mortality, and less metabolic syndrome in studies. | (28, 29) |
| Physical Activity | CVD, diabetes, hypertension, and depression | ≥150 minutes per week of moderate aerobic and resistance training. | 58% decrease in type 2 diabetes incidence; increased VO2 max by 16-17%. | (13, 30-34) |
| Stress Management | Depression, anxiety, CVD, and diabetes | Mindfulness, CBT, meditation, yoga. | Improved mood; lowered blood pressure and cortisol levels. | (35, 36) |
| Avoidance of Risky Substances | CVD, cancer, liver, or respiratory disease | Smoking cessation and alcohol reduction | Decrease in CVD mortality (tobacco); decrease in stroke risk (alcohol). | (28, 37) |
| Sleep Hygiene | Obesity, diabetes, hypertension, and mental health | Sleep schedule, screen limits, treatment of apnea. | Enhanced insulin sensitivity; reduced depressive symptoms. | (28, 38) |
| Social Connection | Mental health and longevity | Social support programs and group interventions | Increased resilience; decreased depression; improved adherence to lifestyle changes. | (39, 40) |

into existing healthcare infrastructures. These barriers warrant further investigation and policy development (23). Despite the rapidly expanding body of literature examining individual lifestyle behaviors and specific chronic diseases, comprehensive reviews integrating all six pillars of lifestyle medicine within a unified conceptual framework remain relatively scarce (24). Most existing reviews focus primarily on isolated risk factors or individual diseases and often fail to address the broader educational, clinical, and public health implications of lifestyle medicine as an emerging discipline. Accordingly, the present narrative review synthesizes current evidence regarding the six core pillars of lifestyle medicine in the prevention and management of NCDs. In addition, it explores the application of lifestyle medicine within clinical practice, public health policy, and health-professional education. Particular emphasis is placed on how modifiable lifestyle factors, including diet, physical activity, smoking cessation, alcohol moderation, sleep, stress reduction, and social connectedness, may be integrated into healthcare systems and population-level strategies to reduce the global burden of chronic disease. Specifically, this review seeks to address three key questions: (1) which components of lifestyle medicine are supported by recent evidence for the prevention and management of major NCDs; (2) what biological and behavioral mechanisms may explain these associations; and (3) what models currently exist for integrating lifestyle medicine into clinical care, policy, and medical education (25-27).

## Materials and Methods

A comprehensive, non-systematic literature search was conducted using PubMed, Web of Science, Scopus, and Google Scholar, supplemented by targeted searches of documents published by authoritative organizations, including the WHO and the American College of Lifestyle Medicine (ACLM). Search terms included combinations of the following keywords: lifestyle medicine, prevention of chronic diseases, NCDs, physical activity, nutrition, plant-based diets, behavioral interventions, randomized controlled trials on NCD prevention, and implementation frameworks. The initial search was performed in June 2025 and subsequently updated in November 2025.

The inclusion criteria encompassed: (1) peer-reviewed systematic reviews, randomized controlled trials, and observational studies with robust methodological quality; (2) position statements, clinical guidelines, and consensus documents issued by major public health agencies and professional organizations; (3) publications published between 2000 and 2025, with particular emphasis placed on evidence from the past decade; and (4) studies demonstrating global relevance or clear implications for healthcare implementation. Sources were excluded if they lacked empirical evidence, focused exclusively on pharmacological interventions, or were not published in English.

More than 130 articles and reports were reviewed, critically appraised for methodological quality and relevance, and subsequently incorporated into the present synthesis. The literature was organized thematically according to the six principal pillars of lifestyle medicine, followed by an examination of implementation strategies at both clinical and policy levels. Owing to the broad scope and narrative nature of the review, formal risk-of-bias and certainty-of-evidence assessments, such as the Cochrane Risk of Bias Tool or GRADE framework, were not conducted. Nevertheless, study design, methodological rigor, and sample size were qualitatively evaluated to determine the relative strength of the available evidence. As a narrative review, this study did not include a quantitative meta-analysis; rather, it provides a conceptual and practice-oriented synthesis

of the evidence intended to inform healthcare professionals, researchers, and policymakers.

**Key Lifestyle Interventions for NCD Prevention and Management**

Lifestyle medicine is founded on the previously described core pillars, each of which targets underlying mechanisms implicated in the development of NCDs, including chronic inflammation, insulin resistance, and endothelial dysfunction (9, 41). In many chronic conditions, lifestyle-based interventions not only complement pharmacological treatment but may also produce effects on intermediate risk factors comparable to those achieved with medication alone (42). When interventions spanning multiple lifestyle domains are implemented concurrently, they appear to exert synergistic effects, thereby reducing the incidence and progression of NCDs, particularly among high-risk populations (25). In the aftermath of the COVID-19 pandemic, these strategies have received increasing global attention as cost-effective and sustainable approaches for enhancing resilience, especially in low- and middle-income countries (LMICs), where the majority of premature NCD-related deaths occur (43, 44).

**Diet and Nutrition**

Unhealthy dietary patterns constitute a major contributor to obesity and metabolic disorders. High consumption of ultraprocessed foods, added sugars, saturated fats, and excessive sodium has been consistently associated with increased risks of hypertension, dyslipidemia, type 2 diabetes, and cardiovascular disease (45). In contrast, dietary patterns rich in whole plant-based foods, including fruits, vegetables, legumes, nuts, and whole grains, and low in processed ingredients, added sugars, and unhealthy fats, have consistently demonstrated protective effects against NCDs.

For instance, meta-analyses have shown that high adherence to Mediterranean-style dietary patterns, characterized by abundant consumption of vegetables, olive oil, nuts, legumes, and whole grains, is associated with approximately a 20% reduction in the incidence of type 2 diabetes and major cardiovascular events (46). Randomized controlled trials further indicate that Mediterranean and comparable dietary approaches can slow the progression of metabolic syndrome while improving blood pressure regulation and lipid profiles (47, 48). In clinical practice, lifestyle counseling commonly encourages increased consumption of vegetables, fruits, legumes, and whole grains, alongside reduced intake of processed red meat, sugar-sweetened beverages, and energy-dense snacks. Importantly, even modest dietary modifications, such as replacing sugar-sweetened beverages with water or increasing dietary fiber intake, may substantially reduce the risk of chronic disease (49, 50).

**Physical Activity**

Physical inactivity is a well-established risk factor for NCDs, with sedentary lifestyles strongly associated with increased prevalence of obesity, hypertension, diabetes, and cardiovascular disease (30). Conversely, regular moderate-to-vigorous physical activity confers broad and well-documented health benefits. Observational evidence demonstrates that adults who meet WHO recommendations, namely at least 150 minutes of moderate-intensity physical activity per week, experience significantly lower risks of premature mortality and chronic disease (51, 52). Exercise exerts beneficial effects across nearly every physiological system. These benefits include reductions in blood pressure, improved insulin sensitivity, increased high-density lipoprotein (HDL) cholesterol levels, decreased visceral adiposity and systemic inflammation, and enhanced psychological well-being and cognitive performance (30). Consequently, the WHO recommends that adults engage in at least 150 minutes of moderate-intensity exercise, 75 minutes of vigorous-intensity

exercise, or an equivalent combination of both each week to optimize health outcomes (53). Frequently recommended activities include brisk walking, cycling, swimming, and jogging, often combined with strength and flexibility training to support overall physical function. Importantly, the benefits of physical activity extend across the lifespan. Promoting active lifestyles among children, adolescents, and older adults may contribute substantially to obesity prevention, preservation of functional independence, and reduction of long-term NCD risk (54). Moreover, given that physical inactivity accounts for a considerable proportion of premature deaths worldwide, it remains a critical target for public health intervention and policy development (55).

**Sleep**

Adequate sleep and effective stress management are essential yet frequently overlooked components of a healthy lifestyle. Chronic sleep deprivation, typically defined as fewer than six to seven hours of sleep per night, as well as excessively prolonged sleep exceeding nine hours, has been associated with elevated risks of obesity, diabetes, hypertension, and cardiovascular disease (56). The biological mechanisms underlying these associations include hormonal dysregulation, particularly involving cortisol and ghrelin, along with increased systemic inflammation resulting from impaired sleep quality and duration. Accordingly, experts emphasize the importance of good sleep hygiene practices, including maintaining consistent sleep schedules, limiting nighttime exposure to electronic screens, and identifying and managing sleep disorders such as obstructive sleep apnea (57, 58).

**Stress Management**

Chronic psychosocial stress arising from occupational, familial, financial, or social pressures significantly increases the risk of NCDs (59). Persistent stress may contribute to disease development both indirectly, through the adoption of unhealthy behaviors, and directly, through physiological mechanisms involving elevated blood pressure, impaired glycemic control, and chronic inflammation (60). Depression and anxiety, for example, have been associated with poorer clinical outcomes among individuals with cardiovascular disease and diabetes (61). Consequently, lifestyle medicine places considerable emphasis on evidence-based stress-management strategies, including mindfulness practices, meditation, cognitive coping techniques, and regular physical activity, while also encouraging the maintenance of a healthy work-life balance (62). Interventions such as cognitive-behavioral therapy and community-based psychosocial support programs have demonstrated potential to improve mental well-being and attenuate the progression of chronic disease (63). Furthermore, routine assessment of sleep quality and psychological stress during clinical evaluations may enable healthcare professionals to address psychosocial determinants of health alongside dietary and physical activity interventions (64).

**Social Connection**

Social connection has increasingly been recognized as a critical pillar of lifestyle medicine. This domain encompasses both objective social isolation and the subjective experience of loneliness, two constructs that may not necessarily coincide (65). Recent global data indicate that loneliness affects a substantial proportion of the population at any given time, prompting major health organizations to identify social disconnection as an emerging public health concern (66). Large prospective cohort studies and meta-analyses consistently demonstrate that individuals with stronger social relationships exhibit substantially higher survival rates than those who are socially isolated (67-69). Importantly, the effect sizes observed are comparable to, and in some cases greater than, those

associated with established risk factors such as smoking, obesity, and physical inactivity (70). Poor social connectedness has been linked to increased risks of cardiovascular disease, stroke, depression, and dementia, particularly among older adults and individuals living with preexisting NCDs (71-73). The mechanisms linking social connection to NCD outcomes appear to involve both behavioral and biological pathways (74). Individuals with strong social networks are generally more physically active, more adherent to medication regimens, more likely to attend follow-up appointments, and more likely to maintain healthier dietary habits. In contrast, chronic loneliness is associated with maladaptive coping behaviors, heightened psychological stress, and increased depressive symptomatology (75, 76).

At the physiological level, loneliness and social isolation have been associated with dysregulation of stress-response systems, impaired autonomic balance, and increased pro-inflammatory activity, all of which may contribute to atherosclerosis and metabolic dysfunction (77, 78). Consequently, practical interventions such as social prescribing have emerged, whereby patients are referred to community-based activities, peer-support networks, and group lifestyle programs through trained link workers (79). These interventions aim not only to strengthen social support but also to promote healthier behaviors related to diet, physical activity, and overall well-being (80, 81). Therefore, regular assessment of loneliness and social isolation, together with the incorporation of social-connection interventions into lifestyle medicine frameworks, may enhance both the prevention and long-term management of NCDs.

**Avoidance of Risky Substances**

Tobacco use remains the leading preventable cause of NCDs worldwide (82). Cigarette smoking and the use of other tobacco products are responsible for approximately eight million deaths annually, including nearly seven million deaths attributable directly to smoking and an additional 1.2 million resulting from exposure to secondhand smoke (83, 84). Smoking is the principal cause of lung cancer mortality and substantially increases the risk of myocardial infarction, stroke, chronic respiratory disease, and numerous other malignancies (85). For example, smokers face approximately twice the risk of cardiovascular disease and up to a 30-fold greater risk of lung cancer compared with non-smokers (86). A wide range of public health measures, including tobacco taxation, smoke-free legislation, graphic health warnings, and restrictions on tobacco advertising, have proven highly effective in reducing smoking prevalence and increasing cessation rates. Likewise, clinical interventions such as behavioral counseling and nicotine replacement therapy significantly improve the likelihood of successful smoking cessation (87). Importantly, smoking cessation confers substantial health benefits at any age. Improvements in blood pressure regulation and pulmonary function may occur within months of quitting, while, after approximately 10 to 15 years of sustained abstinence, the risk of cardiovascular disease approaches that observed among non-smokers. Consequently, healthcare systems increasingly emphasize routine tobacco-use screening and cessation support during all clinical encounters.

At the global level, the WHO Framework Convention on Tobacco Control (FCTC), together with the MPOWER package of tobacco-control measures, provides a comprehensive international framework for reducing tobacco use. Countries implementing stringent tobacco-control policies have consistently demonstrated substantial long-term declines in smoking prevalence (88-91).

Alcohol consumption, particularly heavy and hazardous drinking, likewise constitutes a major risk factor for NCDs (92). In the United States, the annual number of deaths associated with excessive alcohol use, including deaths

partially or wholly attributable to alcohol consumption, increased by approximately 29%, rising from 137,927 in 2016-2017 to 178,307 in 2020-2021 (93, 94). Excessive alcohol consumption has been strongly associated with liver cancer, esophageal cancer, breast cancer, hypertension, and other chronic health conditions (95). Importantly, although the majority of alcohol-related harm is linked to heavy episodic drinking, emerging evidence suggests that even low levels of alcohol consumption may carry measurable health risks (96). Accordingly, public health guidelines generally recommend limiting alcohol intake and incorporating regular alcohol-free days into weekly routines (97). Population-level policy interventions, including alcohol taxation, restrictions on sales hours, and bans on alcohol advertising, have demonstrated effectiveness in reducing alcohol consumption across diverse settings (98). Within clinical practice, screening for hazardous alcohol use and implementing brief interventions, including Screening, Brief Intervention, and Referral to Treatment (SBIRT), can facilitate early identification and management of at-risk individuals (99). Overall, reducing harmful alcohol consumption constitutes a central component of the WHO strategy for NCD prevention and complements broader efforts targeting tobacco use, nutrition, and other modifiable lifestyle risk factors (100).

## Implementing Lifestyle Medicine in Healthcare and Policy

### Clinical Implementation in Primary Care and Health Services

The expanding evidence base supporting lifestyle-oriented prevention and treatment strategies has led to the increasing incorporation of lifestyle medicine principles into clinical guidelines and healthcare systems worldwide. Major medical organizations and public health authorities now recognize lifestyle modification as either a foundational or complementary component of care for numerous chronic diseases (4). Current hypertension guidelines, for example, emphasize dietary modification, including adherence to the Dietary Approaches to Stop Hypertension (DASH) diet and sodium reduction, together with regular physical activity, as first-line strategies before intensifying pharmacological treatment. Similarly, diabetes management guidelines increasingly prioritize weight reduction, nutritional optimization, and plant-predominant dietary patterns, while cardiovascular disease guidelines advocate cardiac rehabilitation programs incorporating dietary counseling and structured exercise interventions (101, 102). These recommendations underscore the increasingly systemic role of lifestyle medicine within contemporary patient care.

To support this transition, interprofessional lifestyle medicine initiatives have expanded substantially in recent years. Medical, nursing, and public health curricula increasingly incorporate dedicated training in nutrition, exercise prescription, behavioral counseling, and health behavior change techniques. In parallel, the development of referral pathways, including exercise prescription programs, dietitian consultations, and smoking-cessation services, reflects ongoing efforts to extend patient support beyond the traditional clinical encounter (42). Collectively, these developments may strengthen healthcare providers' confidence and capacity to integrate lifestyle medicine into routine clinical practice.

### Policy and Environmental Interventions

Governments and public health authorities are progressively incorporating strategies aimed at reducing lifestyle-related risk factors into broader public health and policy frameworks designed to foster healthier environments. WHO-recommended interventions, including the so-called "best buys," encompass evidence-based measures such as taxation of tobacco and alcohol products, elimination of industrial trans fats, mandatory salt reduction in processed

foods, implementation of graphic warning labels, and restrictions on the marketing of unhealthy foods to children (100, 103, 104). In addition to regulatory policies, community-based and environmental interventions play a critical role in facilitating healthier behaviors. Examples include the development of walkable urban environments, expansion of safe public recreational spaces, and implementation of mass-media campaigns promoting healthy lifestyles. Numerous successful population-level interventions have been documented. National salt-reduction initiatives implemented in countries such as Japan, Finland, and the United Kingdom have resulted in substantial reductions in average blood pressure and stroke incidence (105). Likewise, the implementation of a sugar-sweetened beverage tax in Mexico was associated with reduced consumption of soft drinks (106), while multicomponent workplace wellness programs have demonstrated modest but meaningful reductions in employee body weight and blood pressure levels (107).

**Equity, Justice, and Social Determinants of Health**

Addressing social determinants of health is essential for the effective implementation of lifestyle medicine, particularly because low-income and rural populations frequently encounter substantial barriers to accessing nutritious foods, safe environments for physical activity, and smoking-cessation resources (108). Promoting equitable access to healthy lifestyles therefore requires more than simply providing medical advice; it also necessitates the implementation of policies and structural interventions that make healthy choices affordable, accessible, and sustainable across all sectors of society, rather than disproportionately benefiting individuals with higher socioeconomic or educational status (109). Table 2 summarizes major lifestyle intervention trials designed to prevent NCDs.

A table was developed based on policy recommendations from authoritative organizations, including the ACLM and WHO, and incorporates evidence demonstrating that combining multiple lifestyle pillars produces greater benefits than isolated interventions alone (Table 3). Meta-analyses of observational cohorts and long-term follow-up studies of major lifestyle intervention trials indicate that adopting multiple healthy lifestyle behaviors may reduce the risk of cardiovascular events and all-cause mortality by approximately 40% to 60% compared with adopting few or none of these behaviors (29, 121).

## Discussion

This narrative review had several principal objectives: to synthesize evidence regarding the six pillars of lifestyle medicine and their associations with major NCD outcomes, to outline the key biological and behavioral mechanisms underlying these associations, and to describe current models for implementing lifestyle medicine within healthcare systems.

**Table 2.** Selected Landmark Trials Demonstrating Lifestyle Interventions in NCD Prevention and Management.

| Trial/Study | Focus | Key Outcomes | References |
|---|---|---|---|
| Diabetes Prevention Program (DPP) | Prevention of diabetes in high-risk adults | 58% risk reduction with lifestyle changes compared to 31% with metformin. | (110-112) |
| PREMIER Trial | Lifestyle intervention for hypertension | Around 3.7–4.3 mmHg systolic BP reduction with comprehensive lifestyle + DASH. | (113) |
| Lyon Diet Heart Study | Secondary prevention in coronary disease | Significant decrease in cardiac events with a Mediterranean dietary pattern | (114-116) |
| Look AHEAD | Type 2 diabetes and weight management | 8-9% sustained weight loss achieved through intensive lifestyle intervention. | (117, 118) |
| INTERHEART Study | Global risk factors for myocardial infarction | MI risk is strongly associated with modifiable lifestyle-related factors. | (119, 120) |

**Table 3.** Policy guidelines from authoritative organizations, including evidence, demonstrate that combining pillars yields superior outcomes compared to solitary efforts.

| Pillar | Policy Recommendations | Synergistic Effects | Key Outcomes/Studies | References |
|---|---|---|---|---|
| Nutrition | ACLM: whole-food, plant-based diets to treat and possibly reverse chronic diseases, aiming for remission with high-fiber, low-fat eating. WHO: healthy diets that reduce salt, sugar, and fat to combat the leading risk factors for NCDs. | Combining physical activity and stress management leads to greater LDL reduction, lower systolic BP, and reduced inflammation; adhering to multiple behaviors provides 2.5 times stronger CVD protection than single factors. | Meta-analyses show a 20-44% reduction in CVD risk; the Lyon Diet Heart Study reports 32% fewer cardiac events; there is also a sustained 20% reduction in T2D incidence at 20-year follow-up. | (122-125) |
| Physical Activity | ACLM: at least 150 minutes per week of moderate aerobic and resistance exercise to reduce NCDs. WHO: maintaining an active lifestyle to combat physical inactivity. | Proper nutrition and avoiding smoking lower triglycerides, fasting glucose, and CVD risk; improve neurotransmitter regulation to prevent NCDs. | DPP trial: 58% T2D risk reduction; VO2 max improved 16-17%; long-term CVD mortality reduction in Da Qing study. | (13, 34, 122, 126-128) |
| Restorative Sleep | ACLM: the importance of getting 7-9 hours of restorative sleep to support health recovery in obesity and T2D, incorporating this into intensive therapeutic lifestyle change (ITLC). | Engaging in stress management and social activities enhances well-being, helps regulate hormones such as cortisol, and increases the metabolic benefits of diet and exercise. | Data show that a substantial portion of adherence is associated with improved well-being, resulting in fewer depressive symptoms and a lower risk of NCDs in combined interventions. | (28, 127, 129) |
| Stress Management | ACLM: mindfulness/yoga to the six-pillar approach for reducing chronic inflammation; least followed but vital for obesity/T2D. | The strongest predictor of flourishing, combined with sleep and social interactions, reduces HPA axis overactivation and improves insulin sensitivity. | The Patient Empowerment Program (PEP) program reduced all-cause mortality and improved quality of life in patients with NCDs. | (36, 130) |
| Avoidance of Risky Substances | ACLM: avoiding tobacco, excess alcohol, and deprescribing medications when lifestyle changes suffice to manage comorbidities. WHO: reducing smoking and harmful alcohol use through cost-effective bans and taxes. | Diet/activity strongly affects CVD; raises LDL, but combined efforts reduce mortality by 36%. | Graphic warnings: DALY; reduction in vascular risk; Da Qing: reduction in CVD mortality. | (123, 124, 131) |
| Positive Social Connections | ACLM: connections to boost resilience and integrate into care for overall health. WHO emphasizes community approaches to prevent NCDs. | Stress and exercise boost well-being, reduce isolation-related obesity and CVD, and increase the likelihood of flourishing across multiple pillars. | Reduced depressive symptoms; PEP: HR for CVD events; buffers stress for improved NCD outcomes. | (132, 133) |
| Multi-Pillar | ACLM: all six pillars in ITLC for maximal dosing/remission; WHO: Multi-risk factor strategies for NCDs. | Significant decrease in T2D risk; increased likelihood of flourishing; policy reinforcements boost benefits. | Associated with reductions in type 2 diabetes and cardiovascular events in trials, modeling studies indicate broad multi-pillar strategies could significantly lower NCD mortality at the population level. | (29, 33, 134-136) |

The reviewed studies consistently indicate that healthier dietary patterns, regular physical activity, restorative sleep, stress-management strategies, avoidance of tobacco and harmful alcohol use, and stronger social relationships are associated with lower incidence and slower progression of cardiovascular disease, type 2 diabetes, certain cancers, and other chronic conditions (137, 138). Simultaneously, implementation studies demonstrate that integrating multi-pillar lifestyle approaches into primary care, community programs, and medical education is feasible, although adoption remains uneven and highly context dependent.

NCDs remain the leading causes of morbidity, mortality, and healthcare expenditure worldwide. Nevertheless, a substantial proportion of this burden arises from a limited number of modifiable lifestyle-related factors. Large prospective cohort studies and predictive models suggest that combinations of several low-risk lifestyle behaviors, including maintaining a healthy body weight, engaging in regular physical activity, and consuming a nutritious plant-based diet, may prevent a substantial proportion of major chronic diseases and premature deaths. Some analyses have reported relative risk reductions of approximately 70% to 80% for composite outcomes among individuals with the healthiest lifestyle profiles compared with those with the least healthy profiles (14, 139, 140). Extensive cohort studies further indicate that individuals who adopt four or five healthy lifestyle factors may gain an additional decade or more of life free from cancer, cardiovascular disease, and type 2 diabetes compared with individuals who do not adopt low-risk lifestyle factors. These findings underscore that lifestyle behaviors influence not only lifespan but also the number of healthy, disease-free years lived (139, 141, 142). Collectively, the evidence reviewed across the six pillars of lifestyle medicine, namely nutrition, physical activity, restorative sleep, stress management, avoidance of risky substances, and fostering positive social connections, strongly supports the premise that comprehensive behavior-based strategies can address the root causes of major NCDs rather than merely managing their advanced clinical manifestations (9, 143).

The available evidence further indicates that lifestyle medicine is not only theoretically effective but also clinically practical and economically sustainable. Randomized controlled trials and long-term studies of structured lifestyle programs for the prevention of diabetes and cardiovascular disease demonstrate substantial and sustained reductions in disease risk. In parallel, systematic reviews of economic evaluations consistently show these interventions to be cost-effective, and in some cases cost-saving, compared with standard care, particularly in high-risk populations (9, 144-147). Emerging research on co-created, community-based lifestyle interventions further suggests that tailoring programs to the needs and cultural contexts of specific populations may improve engagement, facilitate sustainable behavior change, and enhance both physical and mental health outcomes, although additional long-term evidence remains necessary (148, 149). At the same time, implementation research conducted across diverse healthcare systems, particularly in low- and middle-income countries, highlights both the considerable promise and the substantial challenges associated with integrating lifestyle-oriented NCD prevention and management into primary healthcare.

Over the past decade, lifestyle medicine has evolved from a collection of preventive clinical practices into a recognized medical specialty with formal board certification pathways and dedicated curricula integrated into many medical schools and residency programs (9, 11, 150). This educational expansion is particularly important because it may help address

longstanding gaps in professional training related to nutrition, physical activity, behavior change counseling, and social determinants of health.

Nevertheless, major challenges remain, including limitations in workforce capacity, insufficient funding, and structural barriers within healthcare systems (44, 151). These findings emphasize the importance of integrating lifestyle medicine into reorganized healthcare systems and supportive environments rather than relying solely on individual behavior change (9). Lifestyle medicine incorporates these principles into patient care, thereby providing a framework that complements conventional treatment approaches with proactive prevention strategies. Given the immense societal and economic burden imposed by NCDs, healthcare systems and governments worldwide are increasingly prioritizing lifestyle-focused prevention initiatives (152, 153). By consistently implementing evidence-based lifestyle interventions in both communities and clinical settings, substantial reductions in premature morbidity and mortality may be achievable (154, 155).

**Limitations**

This narrative review has several limitations that should be acknowledged. First, the literature search was non-systematic and therefore may not have captured all relevant studies, particularly non-English publications and reports indexed outside the selected databases. Second, no formal risk-of-bias or certainty-of-evidence assessments, such as Cochrane tools or GRADE, were conducted. Consequently, the strength of evidence derived from different study designs, including randomized controlled trials, cohort studies, and cross-sectional analyses, should be interpreted cautiously.

Third, many of the more substantial effect estimates, including very high relative risk reductions and remission rates, were derived from observational cohorts or highly selected trial populations and therefore may not fully reflect outcomes achievable in routine clinical practice or low-resource settings. Fourth, publication bias is likely present and may have contributed to an overrepresentation of studies reporting positive outcomes associated with lifestyle interventions. Finally, given the broad scope of the topic, important areas such as digital health tools, cultural adaptations, and pediatric populations could only be discussed briefly rather than examined comprehensively.

## Conclusions

Overall, this review supports shifting from viewing lifestyle counseling as an optional adjunct to medical care toward recognizing evidence-based lifestyle medicine as a primary, first-line strategy for the prevention and management of NCDs. If the substantial benefits observed in epidemiological studies, clinical trials, and cost-effectiveness analyses were implemented more broadly through routine lifestyle assessments in clinical settings, multidisciplinary care teams, social connection initiatives, stress-management programs, and policies supporting healthier and more affordable lifestyle choices, the global burden of chronic disease could potentially be reduced considerably, accompanied by substantial increases in healthy life expectancy.

Current evidence suggests that lifestyle medicine offers a unifying framework capable of addressing multiple NCD risk factors simultaneously. However, further research is needed to evaluate long-term outcomes across diverse populations and healthcare settings and to embed lifestyle medicine competencies more comprehensively within mainstream health-professional education. As lifestyle medicine continues to evolve as both a clinical and academic discipline, high-quality research, rigorous implementation science, and thoughtful curriculum design will be essential to fully realize its potential in reducing the global burden of NCDs.

## Future Directions

Despite growing recognition of the importance of lifestyle medicine, substantial implementation barriers remain, including clinician time constraints, limited training in lifestyle counseling, scarce institutional resources, and financial barriers affecting community-based programs. Addressing these challenges will require multifaceted strategies, including reforming medical education to incorporate core lifestyle medicine competencies, expanding digital health tools to improve accessibility and scalability, and fostering broader cultural shifts toward prevention-oriented healthcare.

Innovative approaches, including hospital-based lifestyle medicine initiatives and structured community referral systems, have already demonstrated promising results in terms of both cost-effectiveness and patient outcomes. Future research should therefore prioritize implementation science, equity-focused evaluation, and long-term monitoring of integrated lifestyle programs. Taken together, the current literature suggests that combining clinical care with public health using lifestyle medicine principles represents a promising yet still underutilized strategy for preventing NCDs and bridging the gap between research findings and real-world practice.

Research priorities for 2025 increasingly emphasize low- and middle-income countries, where approximately 82% of premature NCD deaths occur, as well as the use of AI tools for behavior change. Reforming medical education to train future physicians in lifestyle medicine principles is also likely to become increasingly important, particularly as emerging evidence indicates that intensive lifestyle interventions may induce remission of type 2 diabetes in some motivated patients (139, 156). Ultimately, transitioning toward a lifestyle medicine approach will require coordinated efforts among clinicians, policymakers, researchers, and public health institutions to shift healthcare systems from predominantly reactive models toward prevention-oriented care. Addressing implementation barriers through evidence-based strategies may substantially reduce the global NCD epidemic while promoting healthier populations and more sustainable healthcare systems.

## Acknowledgments

The authors would like to express their sincere gratitude to the Deputy of Research and Technology of Fasa University of Medical Sciences.

## Conflict of Interest

The authors declare that they have no conflicts of interest.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Author Contributions

AASN and AE conceptualized the topic and outlined the scope of the review. AASN conducted the literature search, analyzed the findings, and drafted the initial manuscript. AASN and AE contributed to critical revisions of the manuscript and refined its structure and arguments. The authors reviewed and approved the final version of the manuscript.

## Data availability

No data was used for the research described in this article.

## References

1 Al-Maghaireh D, Al Nsour A, Alsaqer K, Kawafha MM, Ireifij AE, Farraj R, et al. A Qualitative Study of Patient Experiences in Non-Communicable Disease Management Within Jordan's Healthy Community Clinics Program. J Multidiscip Healthc. 2025:7089-101.

2 Kazibwe J, Tran PB, Annerstedt KS. The household financial burden of non-communicable diseases in low-and middle-income countries: a systematic review. Health Res Policy Syst. 2021;19(1):96.
3 Katz DL. Lifestyle Medicine and the Far Horizon: Before, Since, and Beyond. Am J Lifestyle Med. 2025:15598276251316268.
4 Grega ML, Shalz JT, Rosenfeld RM, Bidwell JH, Bonnet JP, Bowman D, et al. American College of Lifestyle Medicine expert consensus statement: lifestyle medicine for optimal outcomes in primary care. Am J Lifestyle Med. 2024;18(2):269-93.
5 Budreviciute A, Damiati S, Sabir DK, Onder K, Schuller-Goetzburg P, Plakys G, et al. Management and prevention strategies for non-communicable diseases (NCDs) and their risk factors. Front Public Health. 2020;8:574111.
6 Tanaka A, Node K. Associations of metabolic disorders with hypertension and cardiovascular disease: recent findings and therapeutic perspectives. Hypertens Res. 2024;47(12):3338-44.
7 Rippe JM, Crossley S, Ringer R. Obesity as a chronic disease: modern medical and lifestyle management. J Am Diet Assoc. 1998;98(10):S9-S15.
8 Abe M, Abe H. Lifestyle medicine–An evidence based approach to nutrition, sleep, physical activity, and stress management on health and chronic illness. J Pers Med. 2019;8:3-9.
9 Lippman D, Stump M, Veazey E, Guimarães ST, Rosenfeld R, Kelly JH, et al. Foundations of lifestyle medicine and its evolution. Mayo Clin Proc Innov Qual Outcomes. 2024;8(1):97-111.
10 Pasarica M, Boring M, Lessans S. Current practices in the instruction of lifestyle medicine in medical curricula. Patient Educ Couns. 2022;105(2):339-45.
11 Polak R, Pojednic RM, Phillips EM. Lifestyle medicine education. Am J Lifestyle Med. 2015;9(5):361-7.
12 Frates EP, Xiao RC, Sannidhi D, McBride Y, McCargo T, Stern TA. A web-based lifestyle medicine curriculum: facilitating education about lifestyle medicine, behavioral change, and health care outcomes. JMIR Med Educ. 2017;3(2):e7587.
13 Nyberg ST, Singh-Manoux A, Pentti J, Madsen IE, Sabia S, Alfredsson L, et al. Association of healthy lifestyle with years lived without major chronic diseases. JAMA Intern Med. 2020;180(5):760-8.
14 Katz DL, Frates EP, Bonnet JP, Gupta SK, Vartiainen E, Carmona RH. Lifestyle as medicine: the case for a true health initiative. Am J Health Promot. 2018;32(6):1452-8.
15 Schellenberg ES, Dryden DM, Vandermeer B, Ha C, Korownyk C. Lifestyle interventions for patients with and at risk for type 2 diabetes: a systematic review and meta-analysis. Ann Intern Med. 2013;159(8):543-51.
16 Dickinson HO, Mason JM, Nicolson DJ, Campbell F, Beyer FR, Cook JV, et al. Lifestyle interventions to reduce raised blood pressure: a systematic review of randomized controlled trials. J Hypertens. 2006;24(2):215-33.
17 Mohsen MM, Riad NA, Badawy AI, Abd El-Hammed BM, Elsherbini DMAE. Effectiveness of Life Style Modification on Lipid Profile for Patients with Hyperlipidemia. Am J Nurs. 2020;9(1):8-18.
18 Rosenfeld RM, Grega ML, Karlsen MC, Abu Dabrh AM, Aurora RN, Bonnet JP, et al. Lifestyle interventions for treatment and remission of type 2 diabetes and prediabetes in adults: a clinical practice guideline from the American College of Lifestyle Medicine. Am J Lifestyle Med. 2025;19(2_suppl):10S-131S.
19 Musa S, Dergaa I, Bachiller V, Saad HB. Global implications of COVID-19 pandemic on Adults' lifestyle behavior: the invisible pandemic of noncommunicable disease. Int J Prev Med. 2023;14(1):15.
20 Li Y, Pan A, Wang DD, Liu X, Dhana K, Franco OH, et al. Impact of healthy lifestyle factors on life expectancies in the US population. Circulation. 2018;138(4):345-55.
21 Gradinariu V, Ard J, van Dam RM. Effects of dietary quality, physical activity and weight loss on glucose homeostasis in persons with and without prediabetes in the PREMIER trial. Diabetes Obes Metab. 2023;25(9):2714-22.
22 Balk EM, Earley A, Raman G, Avendano EA, Pittas AG, Remington PL. Combined diet and physical activity promotion programs to prevent type 2 diabetes among persons at increased risk: a systematic review for the Community Preventive Services Task Force. Ann Intern Med. 2015;163(6):437-51.
23 Dobmeyer AC, Hunter CL, Corso ML, Nielsen MK, Corso KA, Polizzi NC, et al. Primary care behavioral health provider training: Systematic development and implementation in a large medical system. J Clin Psychol Med Settings. 2016;23(3):207-24.
24 Vodovotz Y, Barnard N, Hu FB, Jakicic J, Lianov L, Loveland D, et al. Prioritized research for the prevention, treatment, and reversal of chronic disease: recommendations from the lifestyle medicine research summit. Front Med. 2020;7:585744.
25 Arena R, Guazzi M, Lianov L, Whitsel L, Berra K, Lavie CJ, et al. Healthy lifestyle interventions to combat noncommunicable disease—a novel nonhierarchical connectivity model for key stakeholders:

a policy statement from the American Heart Association, European Society of Cardiology, European Association for Cardiovascular Prevention and Rehabilitation, and American College of Preventive Medicine. Eur Heart J. 2015;36(31):2097-109.
26 Crandall JP, Dabelea D, Knowler WC, Nathan DM, Temprosa M. The Diabetes Prevention Program and its Outcomes Study: NIDDK's journey into the prevention of type 2 diabetes and its public health impact. Diabetes Care. 2025;48(7):1101-11.
27 Kaminsky LA, German C, Imboden M, Ozemek C, Peterman JE, Brubaker PH. The importance of healthy lifestyle behaviors in the prevention of cardiovascular disease. Prog Cardiovasc Dis. 2022;70:8-15.
28 Iestra J, Kromhout D, Van der Schouw Y, Grobbee D, Boshuizen H, Van Staveren W. Effect size estimates of lifestyle and dietary changes on all-cause mortality in coronary artery disease patients: a systematic review. Circulation. 2005;112(6):924-34.
29 Barbaresko J, Rienks J, Nöthlings U. Lifestyle indices and cardiovascular disease risk: a meta-analysis. Am J Prev Med. 2018;55(4):555-64.
30 Anderson E, Durstine JL. Physical activity, exercise, and chronic diseases: A brief review. JSHS. 2019;1(1):3-10.
31 Wannamethee SG, Shaper AG, Walker M. Physical activity and mortality in older men with diagnosed coronary heart disease. Circulation. 2000;102(12):1358-63.
32 Boulé NG, Kenny GP, Haddad E, Wells GA, Sigal RJ. Meta-analysis of the effect of structured exercise training on cardiorespiratory fitness in Type 2 diabetes mellitus. Diabetologia. 2003;46(8):1071-81.
33 Group DPPR. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. New England journal of medicine. 2002;346(6):393-403.
34 Taylor RS, Sagar VA, Davies EJ, Briscoe S, Coats AJ, Dalal H, et al. Exercise-based rehabilitation for heart failure. Cochrane Database Syst Rev. 2014;2014(4):CD003331.
35 Sadiq IZ. Lifestyle medicine as a modality for prevention and management of chronic diseases. J Taibah Univ Med Sci. 2023;18(5):1115-7.
36 Pascoe MC, Thompson DR, Ski CF. Yoga, mindfulness-based stress reduction and stress-related physiological measures: A meta-analysis. Psychoneuroendocrinology. 2017;86:152-68.
37 Gallucci G, Tartarone A, Lerose R, Lalinga AV, Capobianco AM. Cardiovascular risk of smoking and benefits of smoking cessation. J Thorac Dis. 2020;12(7):3866.
38 Song SO, He K, Narla RR, Kang HG, Ryu HU, Boyko EJ. Metabolic consequences of obstructive sleep apnea especially pertaining to diabetes mellitus and insulin sensitivity. Diabetes Metab J. 2019;43(2):144-55.
39 Kim ES, Tkatch R, Martin D, MacLeod S, Sandy L, Yeh C. Resilient aging: Psychological well-being and social well-being as targets for the promotion of healthy aging. Gerontol Geriatr Med. 2021;7:23337214211002951.
40 Proctor AS, Barth A, Holt-Lunstad J. A healthy lifestyle is a social lifestyle: The vital link between social connection and health outcomes. Lifestyle Med. 2023;4(4):e91.
41 Potcovaru C-G, Salmen T, Potcovaru AM, Săndulescu I-M, Chiriac O, Balasa A-C, et al. The Long-Term Impact of COVID-19 on Disability after Post-Acute Rehabilitation: A Pilot Study. J Clin Med. 2024;13(16):4694.
42 Frates B. The power and connection of the six pillars. Am J Lifestyle Med. 2023;17(2):216-8.
43 Devi R, Kanitkar K, Narendhar R, Sehmi K, Subramaniam K. A narrative review of the patient journey through the lens of non-communicable diseases in low-and middle-income countries. Adv Ther. 2020;37(12):4808-30.
44 Hategeka C, Adu P, Desloge A, Marten R, Shao R, Tian M, et al. Implementation research on noncommunicable disease prevention and control interventions in low-and middle-income countries: A systematic review. PLoS Med. 2022;19(7):e1004055.
45 Martín-Peláez S, Fito M, Castaner O. Mediterranean diet effects on type 2 diabetes prevention, disease progression, and related mechanisms. A review. Nutrients. 2020;12(8):2236.
46 Esposito K, Chiodini P, Maiorino MI, Bellastella G, Panagiotakos D, Giugliano D. Which diet for prevention of type 2 diabetes? A meta-analysis of prospective studies. Endocrine. 2014;47(1):107-16.
47 Esposito K, Marfella R, Ciotola M, Di Palo C, Giugliano F, Giugliano G, et al. Effect of a Mediterranean-style diet on endothelial dysfunction and markers of vascular inflammation in the metabolic syndrome: a randomized trial. JAMA. 2004;292(12):1440-6.
48 Mitjavila MT, Fandos M, Salas-Salvadó J, Covas M-I, Borrego S, Estruch R, et al. The Mediterranean diet improves the systemic lipid and DNA oxidative damage in metabolic syndrome individuals. A randomized, controlled, trial. Clin Nutr. 2013;32(2):172-8.
49 Al-Jawaldeh A, Abbass MM. Unhealthy dietary

habits and obesity: the major risk factors beyond non-communicable diseases in the eastern mediterranean region. Front Nutr. 2022;9:817808.
50 Mozaffarian D. Dietary and policy priorities for cardiovascular disease, diabetes, and obesity: a comprehensive review. Circulation. 2016;133(2):187-225.
51 Lear SA, Hu W, Rangarajan S, Gasevic D, Leong D, Iqbal R, et al. The effect of physical activity on mortality and cardiovascular disease in 130 000 people from 17 high-income, middle-income, and low-income countries: the PURE study. Lancet. 2017;390(10113):2643-54.
52 Pedersen BK, Saltin B. Exercise as medicine–evidence for prescribing exercise as therapy in 26 different chronic diseases. Scand J Med Sci Sports. 2015;25:1-72.
53 Sandercock GR, Moran J, Cohen DD. Who is meeting the strengthening physical activity guidelines by definition: A cross-sectional study of 253 423 English adults? PLoS One. 2022;17(5):e0267277.
54 Franklin BA, Eijsvogels TM, Pandey A, Quindry J, Toth PP. Physical activity, cardiorespiratory fitness, and cardiovascular health: A clinical practice statement of the ASPC Part I: Bioenergetics, contemporary physical activity recommendations, benefits, risks, extreme exercise regimens, potential maladaptations. AJPC. 2022;12:100424.
55 Lee I-M, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet. 2012;380(9838):219-29.
56 Zarghami F, Karimi K, Salehi S, Akbarpour S, Azizpour Y. The relationship between sleep health characteristics and risk of multimorbidity: A cross-sectional study based on public health surveillance system in southern Tehran-Iran. Prev Med Rep. 2025:103294.
57 Morgan D, Tsai SC. Sleep and the endocrine system. Crit Care Clin. 2015;31(3):403-18.
58 Baranwal N, Phoebe KY, Siegel NS. Sleep physiology, pathophysiology, and sleep hygiene. Prog Cardiovasc Dis. 2023;77:59-69.
59 Devassy SM, Benny AM, Scaria L, Nannatt A, Fendt-Newlin M, Joubert J, et al. Social factors associated with chronic non-communicable disease and comorbidity with mental health problems in India: a scoping review. BMJ open. 2020;10(6):e035590.
60 Mandelli L, Milaneschi Y, Hiles S, Serretti A, Penninx BW. Unhealthy lifestyle impacts on biological systems involved in stress response: hypothalamic–pituitary–adrenal axis, inflammation and autonomous nervous system. Int Clin Psychopharmacol. 2023;38(3):127-35.
61 Watkins LL, Koch GG, Sherwood A, Blumenthal JA, Davidson JR, O'Connor C, et al. Association of anxiety and depression with all-cause mortality in individuals with coronary heart disease. J Am Heart Assoc. 2013;2(2):e000068.
62 Rippe JM. Lifestyle medicine: the health promoting power of daily habits and practices. Am J Lifestyle Med. 2018;12(6):499-512.
63 Nadal IP, Angkurawaranon C, Singh A, Choksomngam Y, Sadana V, Kock L, et al. Effectiveness of behaviour change techniques in lifestyle interventions for non-communicable diseases: an umbrella review. BMC Public Health. 2024;24(1):3082.
64 Hajek A, Bock J-O, König H-H. The use of routine health check-ups and psychological factors—a neglected link. Evidence from a population-based study. J Public Health. 2018;26(2):137-44.
65 Organization WH. World Health Organization. From Loneliness to Social Connection-Charting a Path to Healthier Societies: Report of the WHO Commission on Social Connection. Acta Bioeth. 2026;32(1):173-4.
66 Lim M, Qualter P, Ding D, Holt-Lunstad J, Mikton C, Smith B. Advancing loneliness and social isolation as global health challenges: taking three priority actions. PHRP. 2023;33(3):e3332320.
67 Valtorta NK, Kanaan M, Gilbody S, Ronzi S, Hanratty B. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. Heart. 2016;102(13):1009-16.
68 Wang F, Gao Y, Han Z, Yu Y, Long Z, Jiang X, et al. A systematic review and meta-analysis of 90 cohort studies of social isolation, loneliness and mortality. Nat Hum Behav. 2023;7(8):1307-19.
69 Holt-Lunstad J, Smith TB, Layton JB. Social relationships and mortality risk: a meta-analytic review. PLoS Med. 2010;7(7):e1000316.
70 Qiao L, Wang G, Tang Z, Zhou S, Min J, Yin M, et al. Association between loneliness and dementia risk: A systematic review and meta-analysis of cohort studies. Front Hum Neurosci. 2022;16:899814.
71 Kuiper JS, Zuidersma M, Oude Voshaar RC, Zuidema SU, Van Den Heuvel ER, Stolk RP, et al. Social relationships and risk of dementia: A systematic review and meta-analysis of longitudinal cohort studies. Ageing Res Rev. 2015;22:39-57.
72 Holmes WR, Joseph J. Social participation and healthy ageing: a neglected, significant protective factor for chronic non communicable conditions.

Global Health. 2011;7(1):43.
73 Zhang J, Fang Y, Yao Y, Zhao Y, Yue D, Sung M, et al. Disparities in cardiovascular disease prevalence among middle-aged and older adults: Roles of socioeconomic position, social connection, and behavioral and physiological risk factors. Front Cardiovasc Med. 2022;9:972683.
74 Umberson D, Crosnoe R, Reczek C. Social relationships and health behavior across the life course. Annu Rev Sociol. 2010;36(1):139-57.
75 Warner CB, Roberts AR, Jeanblanc AB, Adams KB. Coping resources, loneliness, and depressive symptoms of older women with chronic illness. J Appl Gerontol. 2019;38(3):295-322.
76 Umberson D, Karas Montez J. Social relationships and health: A flashpoint for health policy. J Health Soc Behav. 2010;51(1_suppl):S54-S66.
77 Cacioppo JT, Cacioppo S, Capitanio JP, Cole SW. The neuroendocrinology of social isolation. Annu Rev Psychol. 2015;66(1):733-67.
78 Smith KJ, Gavey S, RIddell NE, Kontari P, Victor C. The association between loneliness, social isolation and inflammation: A systematic review and meta-analysis. Neurosci Biobehav Rev. 2020;112:519-41.
79 Kong LN, Hu P, Yang L, Cui D. The effectiveness of peer support on self-efficacy and quality of life in adults with type 2 diabetes: a systematic review and meta-analysis. JAN. 2019;75(4):711-22.
80 Napierala H, Krueger K, Kuschick D, Heintze C, Herrmann WJ, Holzinger F. Social prescribing: systematic review of the effectiveness of psychosocial community referral interventions in primary care. IJIC. 2022;22(3):11.
81 Bickerdike L, Booth A, Wilson PM, Farley K, Wright K. Social prescribing: less rhetoric and more reality. A systematic review of the evidence. BMJ open. 2017;7(4):e013384.
82 Chugh A, Jain N, Arora M. Prevention and control of tobacco use as a major risk factor for non-communicable diseases (ncds): a lifecourse approach. Healthy Lifestyle: From Pediatrics to Geriatrics: Springer; 2022. p. 173-97.
83 Crocetti A, Backholer K, Browne J. The commercial determinants of Indigenous health and well-being: a systematic scoping review. BMJ Glob Health. 2022;7(11):e010366-e.
84 He H, Pan Z, Wu J, Hu C, Bai L, Lyu J. Health effects of tobacco at the global, regional, and national levels: results from the 2019 global burden of disease study. Nicotine Tob Res. 2022;24(6):864-70.
85 Leiter A, Veluswamy RR, Wisnivesky JP. The global burden of lung cancer: current status and future trends. Nat Rev Clin Oncol. 2023;20(9):624-39.
86 Dubin S, Griffin D. Lung cancer in non-smokers. Mo Med. 2020;117(4):375.
87 Adekola AD, Alli OI, Mbata AO, Ogbeta CP. Integrating multisectoral strategies for tobacco control: Evidence-based approaches and public health outcomes. IJMABHR. 2023;4(1):60-9.
88 Hiilamo H, Glantz S. Global implementation of tobacco demand reduction measures specified in framework convention on tobacco control. Nicotine Tob Res. 2022;24(4):503-10.
89 Gravely S, Giovino GA, Craig L, Commar A, D'Espaignet ET, Schotte K, et al. Implementation of key demand-reduction measures of the WHO Framework Convention on Tobacco Control and change in smoking prevalence in 126 countries: an association study. Lancet Public Health. 2017;2(4):e166-e74.
90 Britton J. Death, disease, and tobacco. Lancet. 2017;389(10082):1861-2.
91 Ngo A, Cheng K-W, Chaloupka FJ, Shang C. The effect of MPOWER scores on cigarette smoking prevalence and consumption. Prev Med. 2017;105:S10-S4.
92 Kim J, Harper A, McCormack V, Sung H, Houssami N, Morgan E, et al. Global patterns and trends in breast cancer incidence and mortality across 185 countries. Nat Med. 2025:1-9.
93 Esser MB. Deaths from excessive alcohol use—United States, 2016–2021. MMWR Morb Mortal Wkly Rep. 2024;73.
94 Danpanichkul P, Pang Y, Díaz LA, White TM, Sirimangklanurak S, Auttapracha T, et al. Alcohol-Attributable Cancer: Update From the Global Burden of Disease 2021 Study. Aliment Pharmacol Ther. 2025;62(1):33-47.
95 Yoo JE, Han K, Shin DW, Kim D, Kim B-s, Chun S, et al. Association between changes in alcohol consumption and cancer risk. JAMA Netw Open. 2022;5(8):e2228544.
96 Georgescu OS, Martin L, Târtea GC, Rotaru-Zavaleanu A-D, Dinescu SN, Vasile RC, et al. Alcohol consumption and cardiovascular disease: A narrative review of evolving perspectives and Long-Term implications. Life. 2024;14(9):1134.
97 Haber PS. Identification and treatment of alcohol use disorder. New England Journal of Medicine. 2025;392(3):258-66.
98 Malawige AS, Aminde LN, Weeratunga GU, Weerakoon K, Veerman JL. Health impact of alcohol regulatory interventions: a systematic review of policies in low-and middle-income countries. Health Policy and Planning. 2025;40(7):780-804.

99 Hadani Y, Tarikogullari I, Oesterle TS, McGinnis MT, Nidey N, Lai B, et al. Care coordination in screening, brief intervention, and referral to treatment (SBIRT): A scoping review. Am J Addict. 2026;35(1):22-35.
100 Organization WH. Tackling NCDs: best buys and other recommended interventions for the prevention and control of noncommunicable diseases: World Health Organization; 2024.
101 Filippou C, Tatakis F, Polyzos D, Manta E, Thomopoulos C, Nihoyannopoulos P, et al. Overview of salt restriction in the Dietary Approaches to Stop Hypertension (DASH) and the Mediterranean diet for blood pressure reduction. Rev Cardiovasc Med. 2022;23(1):36.
102 Filippou CD, Tsioufis CP, Thomopoulos CG, Mihas CC, Dimitriadis KS, Sotiropoulou LI, et al. Dietary approaches to stop hypertension (DASH) diet and blood pressure reduction in adults with and without hypertension: a systematic review and meta-analysis of randomized controlled trials. Adv Nutr. 2020;11(5):1150-60.
103 Baatiema L, Sanuade OA, Kretchy IA, Okoibhole L, Kushitor SB, Haghparast-Bidgoli H, et al. Implementation of national policies and interventions (WHO Best Buys) for non-communicable disease prevention and control in Ghana: a mixed methods analysis. Health Res Policy Syst. 2024;22(1):154.
104 Joseph R, Hart NH, Bradford N, Wallen MP, Han CY, Pinkham EP, et al. Essential elements of optimal dietary and exercise referral practices for cancer survivors: expert consensus for medical and nursing health professionals. Support Care Cancer. 2023;31(1):46.
105 Song J, Tan M, Wang C, Brown MK, Pombo-Rodrigues S, MacGregor GA, et al. Salt intake, blood pressure and cardiovascular disease mortality in England, 2003–2018. J Hypertens. 2023;41(11):1713-20.
106 Grogger J. Soda taxes and the prices of sodas and other drinks: evidence from Mexico. Am J Agric Econ. 2017;99(2):481-98.
107 Peñalvo JL, Sagastume D, Mertens E, Uzhova I, Smith J, Wu JH, et al. Effectiveness of workplace wellness programmes for dietary habits, overweight, and cardiometabolic health: a systematic review and meta-analysis. Lancet Public Health. 2021;6(9):e648-e60.
108 Thornton RL, Glover CM, Cené CW, Glik DC, Henderson JA, Williams DR. Evaluating strategies for reducing health disparities by addressing the social determinants of health. Health affairs. 2016;35(8):1416-23.
109 Jayasinghe S, Byrne NM, Hills AP. The culture of healthy living-The international perspective. Prog Cardiovasc Dis. 2025;90:51-5.
110 Aroda VR, Knowler WC, Crandall JP, Perreault L, Edelstein SL, Jeffries SL, et al. Metformin for diabetes prevention: insights gained from the diabetes prevention program/diabetes prevention program outcomes study. Diabetologia. 2017;60(9):1601-11.
111 Ratner RE, Group DPPR. An update on the diabetes prevention program. Endocr Pract. 2006;12:20-4.
112 Demissie GD, Birungi J, Shrestha A, Haregu T, Thirunavukkarasu S, Oldenburg B. The effectiveness of lifestyle interventions in reducing cardiovascular risk and risk factors in people with prediabetes: A systematic review and meta-analysis. Nutr Metab Cardiovasc Dis. 2025:104130.
113 Group WGotPCR. Effects of comprehensive lifestyle modification on blood pressure control: main results of the PREMIER clinical trial. JAMA. 2003;289(16):2083-93.
114 De Lorgeril M, Salen P, Martin J-L, Monjaud I, Delaye J, Mamelle N. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. Circulation. 1999;99(6):779-85.
115 Delgado-Lista J, Alcala-Diaz JF, Torres-Peña JD, Quintana-Navarro GM, Fuentes F, Garcia-Rios A, et al. Long-term secondary prevention of cardiovascular disease with a Mediterranean diet and a low-fat diet (CORDIOPREV): a randomised controlled trial. Lancet. 2022;399(10338):1876-85.
116 De Lorgeril M, Renaud S, Salen P, Monjaud I, Mamelle N, Martin J, et al. Mediterranean alpha-linolenic acid-rich diet in secondary prevention of coronary heart disease. Lancet. 1994;343(8911):1454-9.
117 Group LAR. Eight-year weight losses with an intensive lifestyle intervention: the look AHEAD study. Obesity. 2014;22(1):5-13.
118 Unick JL, Beavers D, Jakicic JM, Kitabchi AE, Knowler WC, Wadden TA, et al. Effectiveness of lifestyle interventions for individuals with severe obesity and type 2 diabetes: results from the Look AHEAD trial. Diabetes Care. 2011;34(10):2152-7.
119 Gustavsson J. Genes, Lifestyle and Coronary Heart Disease Risk Epidemiological Interaction Studies. Atherosclerosis. 2012;220:486-92.
120 Wallert J, Madison G, Held C, Olsson E. Cognitive ability, lifestyle risk factors, and two-year survival in first myocardial infarction men: a Swedish National Registry study. Int J Cardiol. 2017;231:13-7.

121 Nechuta SJ, Shu X-O, Li H-L, Yang G, Xiang Y-B, Cai H, et al. Combined impact of lifestyle-related factors on total and cause-specific mortality among Chinese women: prospective cohort study. PLoS Med. 2010;7(9):e1000339.
122 Almutairi M, Almutairi AA, Alodhialah AM. The Influence of Lifestyle Modifications on Cardiovascular Outcomes in Older Adults: Findings from a Cross-Sectional Study. Life. 2025;15(1):87.
123 Nguyen T-P-L, Rokhman MR, Stiensma I, Hanifa RS, Ong TD, Postma MJ, et al. Cost-effectiveness of non-communicable disease prevention in Southeast Asia: a scoping review. Front Public Health. 2023;11:1206213.
124 Rutters F, den Braver NR, Lakerveld J, Mackenbach JD, van der Ploeg HP, Griffin S, et al. Lifestyle interventions for cardiometabolic health. Nat Med. 2024;30(12):3455-67.
125 Fritz M, Grimm M, Hanh HTM, Koot JA, Nguyen GH, Nguyen T-P-L, et al. Effectiveness of community-based diabetes and hypertension prevention and management programmes in Indonesia and Viet Nam: a quasi-experimental study. BMJ Glob Health. 2024;9(5).
126 Taylor RS, Sagar VA, Davies EJ, Briscoe S, Coats AJ, Dalal H, et al. Exercise-based rehabilitation for heart failure. Cochrane Database Syst Rev. 2014(4).
127 Hirashiki A, Shimizu A, Nomoto K, Kokubo M, Suzuki N, Arai H. Systematic review of the effectiveness of community intervention and health promotion programs for the prevention of non-communicable diseases in Japan and other East and Southeast Asian countries. Circ Rep. 2022;4(4):149-57.
128 Group DPPOSR, Group pobotDR, Orchard T, Temprosa M, Barrett-Connor E, Fowler S, et al. Long-term effects of the Diabetes Prevention Program interventions on cardiovascular risk factors: a report from the DPP Outcomes Study. Diabet Med. 2013;30(1):46-55.
129 Burke J, Dunne PJ. Lifestyle medicine pillars as predictors of psychological flourishing. Front Psychol. 2022;13:963806.
130 Ramos SF, Amadigi FR, Gonçalves N, Souza THd, Machado RR, Meirelles BHS, et al. Health intervention projects: strategic action to combat chronic and non-communicable diseases. Texto Contexto Enferm. 2025;34:e20240214.
131 Li G, Zhang P, Wang J, An Y, Gong Q, Gregg EW, et al. Cardiovascular mortality, all-cause mortality, and diabetes incidence after lifestyle intervention for people with impaired glucose tolerance in the Da Qing Diabetes Prevention Study: a 23-year follow-up study. Lancet Diabetes Endocrinol. 2014;2(6):474-80.
132 Harshfield EL, Pennells L, Schwartz JE, Willeit P, Kaptoge S, Bell S, et al. Association between depressive symptoms and incident cardiovascular diseases. JAMA. 2020;324(23):2396-405.
133 Rajan S, McKee M, Rangarajan S, Bangdiwala S, Rosengren A, Gupta R, et al. Association of symptoms of depression with cardiovascular disease and mortality in low-, middle-, and high-income countries. JAMA psychiatry. 2020;77(10):1052-63.
134 Gong Q, Zhang P, Wang J, Ma J, An Y, Chen Y, et al. Morbidity and mortality after lifestyle intervention for people with impaired glucose tolerance: 30-year results of the Da Qing Diabetes Prevention Outcome Study. Lancet Diabetes Endocrinol. 2019;7(6):452-61.
135 An Y, Zhang P, Wang J, Gong Q, Gregg EW, Yang W, et al. Cardiovascular and all-cause mortality over a 23-year period among Chinese with newly diagnosed diabetes in the Da Qing IGT and Diabetes Study. Diabetes Care. 2015;38(7):1365-71.
136 Tu Z-Z, Lu Q, Zhang Y-B, Shu Z, Lai Y-W, Ma M-N, et al. Associations of combined healthy lifestyle factors with risks of diabetes, cardiovascular disease, cancer, and mortality among adults with prediabetes: four prospective cohort studies in China, the United Kingdom, and the United States. Engineering. 2023;22:141-8.
137 Astrup A. Healthy lifestyles in Europe: prevention of obesity and type II diabetes by diet and physical activity. Public Health Nutr. 2001;4(2b):499-515.
138 Medina-Remon A, Kirwan R, Lamuela-Raventos RM, Estruch R. Dietary patterns and the risk of obesity, type 2 diabetes mellitus, cardiovascular diseases, asthma, and neurodegenerative diseases. Critical reviews in food science and nutrition. 2018;58(2):262-96.
139 Li Y, Schoufour J, Wang DD, Dhana K, Pan A, Liu X, et al. Healthy lifestyle and life expectancy free of cancer, cardiovascular disease, and type 2 diabetes: prospective cohort study. BMJ. 2020;368.
140 Ford ES, Bergmann MM, Kröger J, Schienkiewitz A, Weikert C, Boeing H. Healthy living is the best revenge: findings from the European Prospective Investigation Into Cancer and Nutrition-Potsdam study. Arch Intern Med. 2009;169(15):1355-62.
141 Van Dam RM, Li T, Spiegelman D, Franco OH, Hu FB. Combined impact of lifestyle factors on mortality: prospective cohort study in US women. BMJ. 2008;337.
142 Ng R, Sutradhar R, Yao Z, Wodchis WP, Rosella LC.

Smoking, drinking, diet and physical activity—modifiable lifestyle risk factors and their associations with age to first chronic disease. Int J Epidemiol. 2020;49(1):113-30.
143 Du Y, de Bock GH, Vonk JM, Pham AT, van der Ende MY, Snieder H, et al. Lifestyle factors and incident multimorbidity related to chronic disease: a population-based cohort study. Eur J Ageing. 2024;21(1):37.
144 Alouki K, Delisle H, Bermúdez-Tamayo C, Johri M. Lifestyle interventions to prevent type 2 diabetes: a systematic review of economic evaluation studies. J Diabetes Res. 2016;2016(1):2159890.
145 Ma J, Wan X, Wu B. The Cost-Effectiveness of Lifestyle Interventions for Preventing Diabetes in a Health Resource-Limited Setting. J Diabetes Res. 2020;2020(1):7410797.
146 Zhou X, Siegel KR, Ng BP, Jawanda S, Proia KK, Zhang X, et al. Cost-effectiveness of diabetes prevention interventions targeting high-risk individuals and whole populations: a systematic review. Diabetes Care. 2020;43(7):1593-616.
147 Sun Y, You W, Almeida F, Estabrooks P, Davy B. The effectiveness and cost of lifestyle interventions including nutrition education for diabetes prevention: a systematic review and meta-analysis. J Acad Nutr Diet. 2017;117(3):404-21. e36.
148 Feldman AL, Long GH, Johansson I, Weinehall L, Fhärm E, Wennberg P, et al. Change in lifestyle behaviors and diabetes risk: evidence from a population-based cohort study with 10 year follow-up. International Journal of Behavioral Nutrition and Physical Activity. 2017;14(1):39.
149 Anieto EM, Dall PM, Abaraogu U, Chastin S, Anieto IB, Longworth GR, et al. The effectiveness of co-created lifestyle interventions in improving health behaviour, physical and mental health in adults with non-communicable diseases: A systematic review with meta-analysis. Public Health. 2025;248:105929.
150 Rea B, Worthman S, Shetty P, Alexander M, Trilk JL. Medical education transformation: lifestyle medicine in undergraduate and graduate medical education, fellowship, and continuing medical education. Am J Lifestyle Med. 2021;15(5):514-25.
151 Gassner L, Zechmeister-Koss I, Reinsperger I. National strategies for preventing and managing non-communicable diseases in selected countries. Front Public Health. 2022;10:838051.
152 Geer MI. Integrating Holistic Medicine with Integrative Medicine and Lifestyle Medicine for Better Health Outcomes. JIMPH. 2024;3(2):51-5.
153 Vos RC, van Osch LA, van Bilsen JH, Knapen M, Evers AW, Hopman MT, et al. Evidence-based implementation of lifestyle medicine in healthcare practice: a research agenda. Fam Med Community Health. 2025;13(3):e003324.
154 Lianov LS, Adamson K, Kelly JH, Matthews S, Palma M, Rea BL. Lifestyle medicine core competencies: 2022 update. Am J Lifestyle Med. 2022;16(6):734-9.
155 Imtiaz ZI, Khan SE, Ahmad AMR. Lifestyle interventions to reduce non-communicable disease risk in female secondary school teachers of Islamabad; a quasi-experimental mixed-methods protocol. Front Public Health. 2025;13:1641499.
156 do Nascimento Cândido G, Batalha APDB, da Silva Chaves GS, Pereira DS, Britto RR. Effects of exercise training parameters on cardiorespiratory fitness of individuals with type 2 diabetes mellitus: a systematic review and meta-analysis. J Diabetes Metab Disord. 2023;22(1):97-118.