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Effects of Regular Physical Activity on Metabolic, Cardiovascular and Cancer Outcomes: A Review of Current Evidence

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ABSTRACT

Introduction. Physical activity is a key determinant of population health and plays a central role in preventing and managing chronic diseases, including obesity, cardiovascular diseases, type 2 diabetes, and certain cancers. Despite strong evidence, global inactivity remains high, contributing to rising metabolic and cardiovascular burdens.

Materials and Methods. This review synthesizes evidence from systematic reviews, meta-analyses, randomized controlled trials, and international guidelines (ACSM, AHA, ADA, EASD, ACS), focusing on physical activity, exercise physiology, obesity, cardiovascular diseases, diabetes, and cancer prevention.

Results. Regular physical activity improves health across major chronic diseases. In obesity, 150–300 minutes of aerobic activity per week plus resistance training reduces body fat, especially visceral adiposity. For cardiovascular diseases, recommended activity levels lower incidence by 14–22% and mortality by 28–40%. In type 2 diabetes, structured exercise ≥8 weeks reduces HbA1c by 0.4–1.0% and improves insulin sensitivity independently of weight loss. Moderate-to-vigorous activity decreases the risk of colorectal, breast, and endometrial cancers, with probable benefits for kidney, bladder, and gastric cancers. Higher activity levels confer additional protective effects.

Discussion. Benefits of physical activity are mediated via cardiovascular, metabolic, anti-inflammatory, and immune pathways and occur across all ages, independent of weight loss. Barriers such as lack of time, low motivation, and limited access to safe environments highlight the need for systemic interventions, including public health policies, environmental planning,

and community programs. Combined aerobic and resistance training provides the most comprehensive health effects.

Conclusions. Regular physical activity is essential for preventing and managing chronic diseases. Even moderate exercise delivers significant cardiovascular, metabolic, and oncologic benefits, while higher volumes and mixed modalities enhance protection. Public health strategies should prioritize promotion of activity, reduce barriers, and integrate exercise into daily life and clinical practice.

Keywords: physical activity, obesity, cardiovascular diseases, type 2 diabetes, cancer prevention

Introduction

Chronic Diseases and Lifestyle

Chronic diseases are a leading cause of death, disability, and healthcare costs worldwide, representing a major public health challenge. Long-term conditions, such as cardiovascular diseases, diabetes, cancer, obesity, and chronic respiratory diseases, account for nearly two-thirds of global deaths and most years lived with disability. Their burden increases with population aging and the persistence of risk factors such as tobacco use, unhealthy diet, and physical inactivity [1].

Chronic diseases are defined as conditions that are long-lasting, typically persisting for a year or more, and requiring ongoing medical care and/or limiting daily activities [2]. They generally progress slowly and are not self-limiting, which distinguishes them from acute illnesses [3–4]. According to the World Health Organization (WHO), “chronic diseases are defined as conditions of long duration, usually with a slow progression, and are not transmitted from person to person”, thereby classifying them as non-communicable diseases (NCDs) [3].

Lifestyle plays a key role in both the development and prevention of chronic diseases. Major modifiable lifestyle factors—including tobacco use, unhealthy diet, physical inactivity, excessive alcohol consumption, and elevated body mass index (BMI)—are strongly associated with increased risk of NCDs [5, 6]. The American Heart Association (AHA) emphasizes nutrition, physical activity, avoidance of tobacco, and maintenance of a healthy body weight as fundamental components of cardiovascular health and chronic disease prevention [7–8].

Adopting a combination of healthy behaviors is associated with a substantial increase in health-adjusted life expectancy. For example, individuals with an optimal lifestyle—never smoking, maintaining a healthy body weight (BMI <25), engaging in regular physical activity, and consuming alcohol in moderation—live approximately nine years longer without major chronic diseases compared with those following an unhealthy lifestyle [5]. This effect is additive: each additional healthy behavior contributes further to risk reduction and longer health-adjusted life expectancy [5, 6].

Materials and methods

Scientific papers published between 1997 and 2025 were analyzed from databases such as PubMed, Jamanetwork, Journals, AHA Journals focusing on the topic "Physical activity as a prevention of chronic diseases"

Keywords: physical activity, Obesity, Cardiovascular Diseases, Type 2 Diabetes, Cancer Prevention

Results

1.Physical Activity

Physical activity can be classified according to type, intensity, and purpose. The American College of Sports Medicine (ACSM) and Exercise and Sport Science Australia (ESSA) define physical activity as any bodily movement produced by skeletal muscles that increases energy expenditure above the basal level. This includes both incidental activity, such as daily living tasks, and purposeful activity, including physical exercise and sports participation.[9].

1.1. Aerobic Activity

Aerobic activity (also called cardiorespiratory or endurance exercise) involves rhythmic, prolonged movements of large muscle groups, relying mainly on oxidative metabolism. Examples include walking, running, swimming, and cycling. Intensity is typically classified as very low, low, moderate, high, or very high, based on physiological indicators [9–10]. The U.S. Department of Health and Human Services provides descriptors for moderate and vigorous intensity [10].

Physical activity induces molecular and cellular changes that improve cardiovascular, metabolic, musculoskeletal, and immune function. These effects are mediated through increased blood flow, enhanced cardiac output, improved insulin sensitivity, favorable lipid metabolism, and anti-inflammatory signaling. Exercise also triggers epigenetic modifications—such as DNA methylation and histone changes—that regulate gene expression in muscles and

other tissues. These adaptations contribute to long-term health benefits and reduce the risk of chronic diseases [11–15]. The overall effect depends on the type, intensity, and duration of activity, but even moderate regular exercise leads to significant improvements in physical and mental health [11, 16].

1.2. Anaerobic Activity

Anaerobic activity involves high-intensity, short-duration efforts that rely on non-oxidative energy systems such as sprints, plyometrics, maximal weightlifting. These activities are characterized by short, intense bursts and are often performed at high or very high intensity [9, 11].

1.2.1. Endurance Activities

Endurance activities are a subset of aerobic exercises that focus on prolonged, repetitive movements to improve cardiorespiratory fitness and fatigue resistance [9, 12].

1.3. Strength or Resistance Activities

Strength or resistance activities require muscles to exert force against resistance, such as free weights, elastic bands, or body weight.. Intensity is often expressed as a percentage of one-repetition maximum or proximity to neuromuscular fatigue. These exercises improve muscle strength, power, and endurance [9–10].

1.4. Recreational Activities

Recreational activities include sports, dance, yoga, gardening, and other leisure pursuits. Many of these activities are multi-component, combining elements of aerobic exercise, strength, balance, and coordination [9–10].

2. Obesity

Numerous epidemiological studies confirm that reduced physical activity significantly contributes to the development of obesity. Physical activity is a key element of comprehensive therapeutic management of this condition. Obesity is defined as excessive or abnormal accumulation of body fat, leading to poor health. It develops as a result of a positive energy balance resulting from a surplus of calorie intake over expenditure. This, combined with low levels of physical activity, results in the accumulation of excess energy in adipose tissue. [17]

One of the basic indicators for assessing body weight is the BMI (Body Mass Index), calculated as the ratio of body weight (kg) to the square of height (m^2). BMI values in the range of 25.0–29.9 kg/m^2 indicate overweight, while values ≥30.0 kg/m^2 classify the patient as obese. A complementary indicator is waist circumference, which reflects the distribution of body fat; abdominal obesity is diagnosed at a waist circumference >88 cm in women and >102 cm in men. The main factors contributing to the development of obesity include a sedentary lifestyle,

reduced daily physical activity, and excessive energy intake. With increasing affluence and civilizational progress, a global increase in the prevalence of overweight and obesity is observed, as confirmed by numerous epidemiological studies covering populations worldwide. [18,19]

Obesity has become one of the greatest health challenges facing the modern world. It now affects over 890 million adults – it's as if everyone in Europe and North America were overweight. Since 1975, its global prevalence has nearly tripled, and the consequences are increasingly grave: in 2021 alone, overweight and obesity contributed to 3.71 million deaths and took away 129 million disability-adjusted life years. [20,21]

Projections for the coming decades paint a grim picture: by 2050, nearly two in three adults will be overweight or obese, and in many countries in Asia and sub-Saharan Africa, the number of obese people could double. Obesity leads to a cascade of problems – from type 2 diabetes to heart disease and cancer – shortening life and reducing its quality.

It's no longer just a matter of lifestyle. It's a global health crisis, and its growth rate shows no signs of slowing down. [22]

Nowadays approximately 25% of Poles are obese. 53% of women and 68% of men in Poland are overweight. Excess body weight (BMI ≥25) accounts for 14.2% of deaths in Poland (13.1% of men and 15.3% of women). The World Health Organization (WHO) estimates that by 2030, the number of obese children and adolescents will increase by 60%. [23]

Physical activity increases energy expenditure, which promotes weight loss.

Back in 2002, in first conference in Bangkok, experts emphasized that extreme training isn't necessary to truly improve your health. Just 30 minutes of moderate activity a day—walking, cycling, or light exercise—is enough to reduce the risk of heart disease and diabetes. However, if we want to prevent overweight and obesity, a little more activity is needed: 45–60 minutes a day. And people already struggling with obesity should dedicate 60–90 minutes of activity each day to halting further weight gain. [24]

The American College of Sports Medicine presents similar conclusions. Their recommendations include a minimum of 150 minutes of moderate activity per week—the absolute foundation for maintaining weight. Importantly, a growing body of research indicates that more activity yields even better results. For example, around 300 minutes of activity per week can significantly reduce the risk of obesity. For children and adolescents, exercise is the best preventative measure: regular moderate-to-vigorous activity significantly reduces the likelihood of developing overweight and obesity. In other words, the more energy expended on the pitch or playground, the lower the risk of future health problems. [25,26,27]

Meta-analyses show that the most effective strategy for reducing visceral fat, improving body composition, and increasing cardiorespiratory fitness is a combination of high-intensity aerobic training and high-impact resistance training. Research also indicates that high-intensity interval training (HIIT) may be a useful alternative for overweight individuals; however, it is not superior to continuous moderate-intensity exercise for weight loss. [28]

According to the American College of Sports Medicine guidelines, a physical activity program should be individualized, and its effectiveness depends on the amount of exercise—including duration, intensity, and type of activity—as well as on its regularity. It is also emphasized that even short bouts of moderate or higher-intensity activity, which add up to the recommended weekly exercise volume, are important in preventing obesity. [29,30]

3. Cardiovascular Diseases

Physical activity reduces the risk of developing cardiovascular diseases (CVD), lowers cardiovascular mortality, and improves outcomes in individuals with diagnosed CVD [31]. Even small amounts of physical activity provide significant cardiovascular benefits compared with inactivity [31, 33].

Regular physical activity is associated with improvements in systolic and diastolic blood pressure, body weight, and lipid profiles, and is linked to a 21% reduction in the risk of CVD events [31]. Meeting recommended physical activity levels is associated with a 14–22% reduction in the incidence of coronary heart disease and major CVD events, as well as a 28–40% reduction in cardiovascular mortality [32, 34–35].

Dose-response data indicate that higher volumes of physical activity result in greater risk reduction, with benefits plateauing only at very high levels of activity [34]. Physical activity exerts its effects both through modification of traditional risk factors and via direct vascular and anti-inflammatory mechanisms [36].

These benefits are observed across diverse populations and are independent of socioeconomic status or type of activity (recreational, transport-related, or occupational), although recreational and transport-related activity show the strongest associations with reduced CVD risk [34, 37].

In patients with existing CVD, physical activity is strongly associated with lower cause-specific cardiovascular mortality, providing greater relative benefits than in individuals without prior CVD [35]. The American Heart Association emphasizes that promoting physical activity is a key strategy for both primary and secondary prevention of cardiovascular diseases [31, 36, 38].

4. Type 2 Diabetes

Physical activity improves glycemic control in type 2 diabetes, with regular aerobic exercise reducing HbA1c levels by approximately 0.6% and flattening the glucose curve. Both the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD) recommend aerobic and resistance exercise, as each form independently lowers blood glucose, improves cardiovascular fitness, increases muscle strength, and enhances flexibility and balance. Combined aerobic and resistance training is more effective than either modality alone in improving glycemic control and overall health outcomes [39–40].

The ADA recommends at least 150 minutes per week of moderate-intensity aerobic activity, and even small increases in daily activity—for example, 500 additional steps per day—are associated with reduced risk of cardiovascular disease and all-cause mortality. Structured exercise interventions lasting at least eight weeks have been shown to reduce HbA1c by 0.66%, even without significant weight loss. Higher-intensity exercise provides greater improvements in glycemic control and cardiorespiratory fitness [41].

These guidelines are based on the fact that physical activity induces a rapid, insulin-independent increase in glucose uptake by muscles. Moreover, regular exercise triggers multiple metabolic adaptations, including improved insulin sensitivity, increased capillary density, and enhanced metabolic function in skeletal muscle, adipose tissue, and the liver. These benefits occur independently of weight loss and are most pronounced in individuals with higher baseline insulin resistance [40].

The ADA emphasizes the importance of individualizing physical activity recommendations according to the patient's abilities and needs while promoting an interdisciplinary approach to ensure safety and engagement in therapy [41].

Recent meta-analyses and clinical studies have further refined the dose-response relationship for physical activity in type 2 diabetes. A comprehensive meta-analysis of 126 randomized controlled trials showed that approximately 244 minutes per week of moderate-intensity aerobic exercise reduces HbA1c by 0.4–1.0%, with the greatest reductions observed in participants with higher baseline HbA1c levels [42].

Both aerobic and resistance training are effective, and programs combining the two modalities may provide additional metabolic and glycemic benefits [43]. Physical activity also extends beyond glycemic control, contributing to the reduction of visceral and hepatic fat, improving tissue insulin sensitivity, and lowering cardiovascular disease risk.

5. Physical Activity and Cancer Prevention

Physical activity plays an important role in cancer prevention, with strong evidence supporting its protective effects against several types of cancer, particularly colorectal cancer, breast cancer (especially in postmenopausal women), and endometrial cancer. Both the American Cancer Society (ACS) and the American College of Sports Medicine (ACSM) indicate that regular moderate- to vigorous-intensity physical activity is associated with a lower risk of these cancers and may also reduce the risk of kidney, bladder, esophageal (adenocarcinoma), and gastric (cardia) cancers [44–45].

Epidemiological data suggest a dose-response relationship, where higher levels of physical activity correlate with greater risk reduction, although benefits plateau at approximately twice the current recommended activity levels [46].

Physical activity is thought to reduce cancer risk through multiple pathways, including improved insulin sensitivity, reduced inflammation, modulation of sex hormones, enhanced immune surveillance, and maintenance of a healthy body weight [45–48].

For optimal cancer prevention, the ACS recommends that adults engage in 150–300 minutes per week of moderate-intensity physical activity or 75–150 minutes per week of vigorous-intensity activity [45].

Sedentary behavior is an independent risk factor, with prolonged sitting associated with increased risk of colorectal and endometrial cancers, and potentially lung cancer [45]. It is important to note that while physical activity is protective against most cancers, it is linked to an increased risk of melanoma, emphasizing the need for sun protection during outdoor exercise [44].

6. Factors Affecting Physical Activity Levels

Physical activity levels are influenced by individual factors, such as health status, self-efficacy, and motivation; social factors, including social support and cultural norms; and environmental factors, such as access to facilities, neighborhood safety, and urban design.

Common barriers to physical activity include lack of time, fatigue, financial limitations, health restrictions, low motivation, and limited access to safe or attractive environments. Motivators include perceived health benefits, enjoyment, social interactions, stress reduction, and support from family or peers.

Health education and public policy are essential to promote physical activity at the population level. The American Heart Association emphasizes that coordinated policy strategies—such as adapting the built environment, supporting active transportation, and implementing community- and school-based programs—are necessary to remove barriers and create environments that encourage physical activity.

Discussion

Regular physical activity is one of the most important determinants of population health, and accumulated evidence clearly confirms its role in both the prevention and treatment of major chronic diseases. Numerous studies have demonstrated that low levels of physical activity contribute to the development of obesity, metabolic disturbances, and cardiovascular diseases, whereas even moderate increases in daily activity lead to significant health benefits. These effects are driven by complex physiological mechanisms, including improvements in cardiovascular function, glucose regulation, lipid metabolism, reduction of systemic inflammation, and beneficial epigenetic modifications.

These observations are strongly supported by guidelines from the ACSM, AHA, ADA, and ACS, which emphasize that both aerobic and resistance exercise have positive health effects, while combining them yields the greatest overall benefits. Regular physical activity can reduce the risk of cardiovascular disease by 20–40%, and in type 2 diabetes it may improve glycemic control, lowering HbA1c levels by approximately 0.6%.

Conclusions

Current evidence clearly shows that regular physical activity is a key factor in both the prevention and treatment of chronic diseases, including obesity, cardiovascular diseases, type 2 diabetes, and several types of cancer. Even moderate exercise performed consistently leads to important metabolic, cardiovascular, and systemic benefits. Greater amounts of physical activity provide additional protective effects. Both aerobic and resistance training are effective, and combining them offers the most comprehensive health improvements.

As the prevalence of chronic diseases—especially obesity—continues to rise, physical activity must be considered an essential part of clinical interventions and public health programs. It is also necessary to create social and environmental conditions that support everyday movement and reduce barriers to being active. Promoting regular physical activity should be a priority in health policy, as it is one of the most effective, accessible, and evidence-based strategies for improving population health.

In summary, physical activity can be classified according to its physiological demands (aerobic, anaerobic, endurance, and strength/resistance training), its structure (planned vs. incidental), and its context (recreational, occupational, or sports-related). Exercise intensity is further categorized using standardized descriptors.

Adults should engage in at least 150–300 minutes per week of moderate-intensity aerobic activity or 75–150 minutes per week of vigorous-intensity aerobic activity, or an equivalent

combination of both. In addition, muscle-strengthening exercises are recommended two or more times per week.

Lifestyle modification is most effective when it is introduced early and maintained over the life course, as many risk factors track from childhood into adulthood.

Author's contribution

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