

# Integrating Physical Activity into Lifestyle Management of Cardiovascular Disease

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## ABSTRACT

The prevalence of cardiovascular diseases has almost doubled in Nepal from 1990 to 2019, making it the leading cause of death in the country. Despite numerous theories and experiments, satisfactory health outcomes have not been achieved. A holistic approach to lifestyle management is necessary to address the burden of cardiovascular disease. The Center for Disease Control recommends physical activity as a means of lifestyle modification, which can help reduce the risk of cardiovascular disease morbidity and mortality. Using the Metabolic Equivalent, physical activity can be quantified and prescribed based on frequency, intensity, time, type, and progression. Physicians can motivate patients, include physical activity in treatment plans, and refer patients to evidence-based exercise programs by qualified exercise professionals. In addition to individual interventions by physicians, the government should develop and enforce policies aimed at increasing physical activity. This review provides an overview of how physical activity can be integrated into lifestyle medicine to reduce the burden of cardiovascular disease.

**Keywords:** Cardiovascular diseases; exercise; lifestyle.

## INTRODUCTION

Physical inactivity is a major public health issue today<sup>1</sup>, with its role in developing cardiovascular diseases first identified by Morris et al. in 1953.<sup>2</sup> In rural Nepal, undulating terrain promotes physical activity, but in 2021, 66% of Nepalese lived in urban areas where having a healthy lifestyle is difficult.<sup>3</sup> The prevalence of low physical activity in Nepal is high, and a third of coronary artery disease patients reported low physical activity.<sup>4-6</sup> Medical professionals should refocus their efforts on prevention through effective lifestyle choices, including physical activity. Physicians' advice is highly valued by patients, but major barriers to offering physical activity counseling are often lack of time and training.<sup>7</sup> This article aims to encourage physicians to prescribe physical activity to every patient.

### Global Burden of Cardiovascular disease:

The burden of cardiovascular disease (CVD) is significant around the globe, with a rise in prevalence, mortality, and disability-adjusted life years (DALYs) observed over the last few decades. Nepal is one of the countries with a high burden of cardiovascular disease, with it being the leading cause of mortality and morbidity in the country. There

has been a rise in the age-standardized mortality rate for cardiovascular diseases between 1990 (271 million) and 2019 (523 million). Cardiovascular diseases also account for a substantial proportion of Disability-adjusted life years (DALYs) and years of life lost (YLL), both doubling from 17.7 million to 34.4 million (95% UI:24.9 to 43.6 million) and 17.7 million to 34.4 million, respectively. Population growth and aging are likely to result in a substantial increase in total CVD cases. The promotion of ideal cardiovascular health and healthy aging across the lifespan must be given more attention. Further, it is imperative that we implement feasible and affordable preventive and control strategies for CVD and monitor their effectiveness.<sup>8,9</sup>

### Burden of cardiovascular disease in Nepal:

In Nepal, cardiovascular disease is a major cause of both mortality and morbidity. It accounted for 24% of all deaths in 2019 (95% UI: 21.7-26.8) and was the leading cause of DALYs (11.9% of all DALYs). However, there has been some improvement in reducing mortality rates, with an 8.3% decrease in age-standardized cardiovascular mortality from 1990 to 2019, although most of it occurred before 2010. In the last decade, the age-standardized mortality rate for cardiovascular illnesses increased by 5.9%. In

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2019, the leading causes of YLLs were cardiovascular diseases (17.0%, 95% UI: 15.0-19.3). Disaggregated by gender, cardiovascular diseases were the leading cause of YLL among males (19.1% ,95% UI: 16.4-22.3). According to age-standardised rates per 100,000, cardiovascular diseases have risen from fifth place to first in leading causes of YLL. Nevertheless, the age-standardised YLL per 100,000 declined by 19.2% between 1990 and 2019. A substantial decline in YLL per 100,000 occurred between 1990 and 2010, reducing by 20.7%.<sup>10</sup>

#### Lifestyle Practices for Ideal Cardiovascular Health:

Despite numerous advances in understanding cardiovascular diseases, there hasn't been much decline in heart disease related mortality. Hence a shift in the current paradigm from disease management to health promotion is needed, and lifestyle practices play a crucial role. Studies such as seven countries study,<sup>11</sup> framingham study<sup>12</sup> and Ni-hon-san<sup>13</sup> study support the concept that regular physical activity, maintenance of a proper weight, sound nutritional practices, and avoiding tobacco products all significantly reduce the risk of CVD. The American Heart Association's strategic plan for 2020 added the concept of "primordial" prevention (preventing risk factors from developing in the first place) to the concept of "ideal" cardiovascular health which involves lifestyle factors such as regular physical activity, sound nutrition, weight management, and avoidance of tobacco, as well as some cardiovascular health-related factors such as control of cholesterol, blood pressure, and glucose.

However, helping individuals incorporate these practices into their daily lives has been difficult, and few physicians follow guidelines for counseling patients on adopting physical activity, while AHA concluded in 2020 that only 5% of individuals achieved "ideal cardiovascular health".<sup>14</sup> A lack of confidence and skills in the area of lifestyle counseling is a concern for many physicians.<sup>15,16</sup> Through lifestyle management of disease, clinicians recommend therapeutic lifestyle interventions as a primary approach to treat chronic diseases. Clinical consultations are scheduled periodically with patients to discuss their progress and suggest lifestyle changes as per need.<sup>17</sup>

#### Physical Activity-Based Lifestyle Management of Cardiovascular Diseases:

To effectively advise the patients, clinicians need to differentiate between physical activity and exercise. Physical activity refers to any movement that requires contractions of skeletal muscle and causes a higher energy expenditure than basal. Exercise, on the other hand, involves planned, organized, and repeated physical activity aimed at improving health and fitness. While physical activity burns calories and counters the negative consequences of sedentary behavior, exercise improves cardiorespiratory fitness and strengthens muscles, resulting in significant health benefits.<sup>18</sup>

Scientists speculate that hundreds of thousands of years ago, a genome with genes selected for physical activity "fed forward" to humans' healthy metabolisms. However, the modern inactive lifestyle disrupts this, resulting in obesity and related metabolic disorders worldwide. Paleoanthropological investigations support that activity levels have dropped by up to 60% in recent

decades as compared to roughly 100 years ago. Therefore, the author argues that we need to highlight the negative effects of being sedentary or inactive rather than the advantages of exercise or physical activity.<sup>19</sup> Based on the presentation of theoretical changes in population activity levels in industrialized countries over the 20th century by Vogels et al.,<sup>20</sup> we can see how ambient activity levels have changed in Western populations over the past century and its possible causes. Physical inactivity significantly increases the risk of CVD, but less than half of adults meet the minimum recommendation for aerobic exercise. The Centers for Disease Control and Prevention (CDC)<sup>21</sup> and the Physical Activity Guidelines for Americans 2018 (PAGA 2018) recommend the following, which have been summarized in **Figure 1**:

- At least 150 minutes per week of moderate-intensity aerobic exercise and muscle-strengthening activities at least 2 days per week; OR
- At least 75 minutes of vigorous exercise and muscle-strengthening activities at least 2 days per week OR,
- An equivalent mix of moderate- and vigorous-intensity aerobic activity on 2 or more days a week and muscle-strengthening activities at least 2 days per week.

Adaptations can be made to these guidelines to meet the needs of special populations, which include people over 65 years of age, pregnant or post-partum women, and those with chronic health conditions.

- Those over 65 years of age should be aware that they may not be able to reach the above-noted guidelines due to physical or fitness constraints.
- Balance exercises can complement aerobic and strength training for older adults.
- The physical activity guidelines for women who are pregnant or postpartum is at least 150 minutes of moderate aerobic activity spread throughout the week.
- The above guidelines should also be followed by people with chronic diseases, but physical activity should be regulated by their medical conditions.
- Recent guidelines published by the American College of Sports Medicine's International Multidisciplinary Round table on Exercise and Cancer recommend that engaging in 30 minutes of moderately vigorous aerobic activity three times per week is an efficient strategy to combat cancer-related health outcomes.<sup>18,22</sup>

#### Definitions of terms used in the guidelines:

- Moderate-intensity physical activity: Such activities that burn off energy three to six times more when compared to rest state. For eg. Brisk walking, mowing lawn, water aerobics, dancing, cycling slower than 10 miles per hour etc.
- Vigorous intensity physical activity: Such activities that burns off energy seven to six times more when compared to rest state. For. eg. Running, jumping rope, hiking uphill etc.<sup>23</sup>
- Muscle strengthening exercise: This is also called weight training/strength training/resistance training,



**Figure 1:** The physical activity guidelines for American, 2nd edition, 2018<sup>22</sup>

which entails exercises that develop muscle power and endurance. For eg. weight lifting, resistance bands, planks, wall pushup etc.<sup>24</sup>

- Aerobic exercise: Activities which include exercises where a large group of muscles contracts rhythmically for an extended period of time. Such exercises get our heart pumping. For eg. swimming, cycling, dancing, high intensity exercises.<sup>25</sup>

According to the CDC, physically inactive individuals (those who do not meet the above criteria) have double the risk of heart disease compared to physically active individuals (those who meet the criteria). In fact, inactivity has the same negative health effects as smoking a pack of cigarettes per day for smokers.<sup>26</sup> It has been estimated that a 2.3% reduction in physical inactivity between 1980 and 2000 prevented at least 17,445 deaths from coronary heart disease (CHD) in the United States. Despite the clear health benefits of physical activity, many physicians are not adequately prepared to recommend exercise.<sup>27,28</sup> However, a report by the 2018 Physical Activity Guidelines Advisory Committee suggests that even small increases in physical activity could significantly reduce CHD risk for a large portion of the American population. Modest increases in physical activity also help reduce the risk of adult weight gain and control hypertension.<sup>29</sup> Physically active individuals generally have lower blood pressure, with an average difference of 5 mm Hg compared to sedentary adults of the same age. Physical activity levels reduce the risk of heart failure and stroke in a dose-dependent manner. Even a small increase in activity for sedentary individuals, such as daily walks around the block, can have significant health benefits.

#### **Mechanisms of physical activity induced Cardioprotection**

Exercise training offers robust cardioprotection against

myocardial ischemia reperfusion injury, reducing the risk of arrhythmias, transient post-ischemic myocardial dysfunction, and myocardial infarction due to ischemia reperfusion injury. The mechanism of exercise-induced cardioprotection includes increased collateral circulation, modified cardiac myocytes to achieve a cardioprotective phenotype against Ischemia-Reperfusion (IR) injury, such as increased glycolytic flux, alteration in nitric oxide (NO) signaling, increased levels of heat shock proteins (HSPs), amplification of myocardial cyclooxygenase-2 (COX-2) activity, elevation in endoplasmic reticulum (ER) stress proteins, enhancement in function of sarcolemmal and/or mitochondrial ATP-sensitive potassium channels, increased cytosolic antioxidant capacity, and/or alteration in mitochondrial antioxidant capacity of mitochondria. These modifications in cardiac myocytes help to achieve a cardioprotective phenotype.<sup>30</sup>

#### **Evaluation of physical fitness:**

Clinicians may benefit from gathering information about the patient's fitness preferences and values using questions such as "How would you rate your current levels of physical activity?", "What types of physical activities do you enjoy?", and "What role does physical activity play in your life?"<sup>18</sup> It is important to report exercise capacity in Metabolic Equivalents of task (METs) rather than exercise time, so that exercise capacity can be uniformly compared between protocols. A MET is a physiological concept that describes energy expenditure compared to the resting state, with one MET being the energy expenditure at rest, equivalent to approximately 3.5 ml O<sub>2</sub>·kg<sup>-1</sup>·min<sup>-1</sup> or 1 kcal·kg<sup>-1</sup>·h<sup>-1</sup>.<sup>31</sup> Tests and protocols used for evaluating physical fitness include cycle ergometer, ramp testing, submaximal exercise (post MI, post-bypass surgery for risk stratification), walk test for cardiorespiratory fitness, 1-repetition maximum for muscle strength, push-ups for muscle

endurance, Wingate test for anaerobic power, body composition, waist circumference, and skinfold thickness.<sup>32</sup>

#### Addressing 5 'S' (Health-related fitness domains)

Health related fitness is the ability to perform physical activities with ease. It can be categorized into five domains to focus on while designing physical activities.<sup>19</sup> While focusing on each of these domains, physical activity prescriptions should address frequency, intensity, time, type and progression (known by the acronym FITTP).<sup>33</sup>

##### Stamina:

The more commonly used term for stamina is aerobic or cardiovascular fitness. A generic regimen for aerobic exercise includes:

- Frequency: Walking, cycling, and jogging should be performed for 30-60 minutes most days of the week, burning approximately 2500 calories.
- Intensity: Higher levels of intensity are required for fitness improvement, and it is recommended to train between 60-80% of maximum heart rate (determined by the formula 220 minus age). A cost-effective strategy to improve aerobic fitness is high-intensity training over brief intervals (e.g., 20-30 seconds spurts of maximum activity followed by 30-40 seconds of recovery).
- Time: The duration of training ranges from 5 minutes to over 60 minutes, depending on the individual's fitness level, personal goals, motivation, and the type of cardiovascular activity.
- Type: It is recommended to alternate between impact (running) and non-impact training (swimming, cycling).
- Progression: Intervals, duration, and/or intensities of exercise can be increased based on the coach's guidance and the individual's preference.

##### Suppleness:

- Muscle suppleness (flexibility) reduces the incidence of stretch-related injury by maintaining musculoskeletal length and integrity. The muscle suppleness is increased by stretching and holding muscles (without pain). A general regime for flexibility includes:
- Frequency: There are usually two to seven recommended sessions per week. When working in restricted areas, it is often necessary to increase overall volume by increasing the number of days per week and/or sets performed per session.
- Intensity: It is generally recommended to stretch until moderate discomfort is experienced.
- Time: Depending on the goal or type of stretch, it could last from 20 seconds to more than a minute.
- Type: There are three types of stretching: passive, active, and proprioceptive neuromuscular facilitation (PNF).
- Progression: The purpose of progression is to increase joint range of motion toward normal in areas where movement restriction occurs.

##### Size (body fat):

Reducing body fat is primarily influenced by the volume of physical activity, as opposed to stamina and strength, which require gradual increases in intensity. Here are the key factors to consider:

- Frequency: For weight loss goals, increasing the frequency of physical activity beyond the normal recommended guidelines is recommended. Inactive individuals can benefit the most from walking more frequently, even in small increments throughout the day. To monitor progress, a pedometer can be a useful tool.
- Intensity: The intensity of exercise should be planned according to the degree of obesity to achieve weight loss. However, weight loss is mainly affected by the volume rather than the intensity of physical activity.
- Time: Generally, adding 30-60 minutes of moderate to vigorous physical activity per day, per week is recommended for reducing body fat, based on the degree of obesity.
- Type: Aerobic exercise can be supplemented with resistance training to increase fat loss. Resistance training increases metabolic activity of muscles, resulting in greater energy expenditure.
- Progression: Physical activity programs should be adaptable and dynamic to cater to an individual's changing needs.

##### Stability:

As muscle and joint strength decreases with age, the elderly population is more susceptible to falls and bone fractures, making stability crucial. A "planking" position is a helpful exercise for maintaining stability, while gentle exercises like Tai Chi can also promote stability.<sup>18,19</sup> Tai Chi involves slow, low-impact movements that flow through a series of actions named after animal actions, such as "white crane spreads its wings." During Tai Chi practice, muscles are relaxed, joints are not fully extended or bent, and connective tissues are not stretched.<sup>27</sup>

##### Cost-effectiveness:

Chronic diseases have become a major burden for health-care systems worldwide due to their high costs. Lifestyle interventions that are much cheaper can prevent most of these diseases, leading to substantial cost savings by reducing the need for expensive medical care. A model simulation was conducted to evaluate the cost-effectiveness of a lifestyle intervention in the Swedish Björknäs study. The analysis suggested that the intervention would be advantageous in the long run not just due to cost savings but also due to increased quality-adjusted life-years (QALYs).<sup>35</sup>

##### The Role of Physicians in Promoting Increased Physical Activity:

Physician recommendations can be very effective in changing behaviour. In lieu of providing elaborate information, clinicians often vaguely suggest "get some exercise". Exercise cannot be replaced by medication, so it is crucial to understand what will encourage patients to increase their activity levels over the long term, especially in an environment where some form of activity plan that motivates intellectually is required. In the long run, intrinsic motivation will be the most effective way to motivate

patients to persevere. For clinicians to educate themselves and become competent in discussing physical activity with their patients, they must seek out resources. Patients should be evaluated and prescribed physical activity based on the standard guidelines followed worldwide. (As Nepal does not have its own guidelines, we can follow Physical activity guidelines for Americans, 2nd edition, 2018, or Global Recommendations on Physical Activity for Health, World Health Organization, 2020).<sup>23</sup> Clinicians can also record physical activity as a vital sign as self-recorded exercise assessment. Physical Activity Vital Sign (PAVS) has been incorporated into many electronic medical record systems with manpower trained in many settings to obtain information regarding physical activity. The PAVS tool contains the following questions:

1. How often do you engage in moderate-to-strenuous physical activity per week? (such as going for a brisk walk)?
2. When you exercise at this level, how many minutes do you spend doing it on average?
3. How many days a week do you engage in resistance training or bodyweight activities?
4. When you exercise at this level, how many minutes do you spend doing it on average?

The multiplication of list a and b gives the data of physical activity in number, which clinicians can use to approximate how closely a patient comes to meeting the 150 minutes per week of moderate-intensity activity. Similarly, the multiplication of alphabet bullet list c and d gives data on vigorous physical activity per week.<sup>36</sup>

Before starting or progressing an exercise program, the American College of Sports Medicine (ACSM) suggests getting screened. The goal is to identify those who may be at higher risk for exercise-related sudden cardiac death (SCD) and/or acute myocardial infarction. The "Exercise pre-participation health screening questionnaire" is a checklist created by Magal et al.<sup>37</sup> to simplify the pre-participation screening procedure. The American College of Sports Medicine pre-participation screening algorithm is simplified by Riebe et al.<sup>38</sup> Although vigorous exercise has low cardiovascular event risks, individuals should undergo screening to detect their susceptibility.<sup>32</sup> It is also recommended that clinicians provide a prescribed number of physical activities. An expanding body of evidence supports the standard practice of providing a written prescription for physical activities to patients, such as the "Green Prescription" initiative, which was introduced in New Zealand in 1998.<sup>36</sup> Patients who were instructed to increase their physical activity instead tended to curtail by about 15 minutes a week. Patients who were prescribed physical activity (medical advice, instructional resources, and a tailored physical activity plan) improved their physical activeness. Within six months of being prescribed physical activity, both younger (< 50-year-old) and older patients increased their weekly physical activity by an average of 30 and 65 minutes, respectively.<sup>39</sup>

As part of lifestyle medicine, physical activity consultation, it's crucial to promote non-exercise activity thermogenesis (NEAT), which can be done by encouraging two-minute bursts of light to moderate-intensity walking every 20 minutes. With pedometers, individuals can pas-

sively monitor their step count and obtain in-app information based on desired steps to reach per day to help decrease sitting time. It promotes both physical and mental health by decreasing passivity. The use of a pedometer may also prove to be an effective motivational tool.

Lastly, patients' perceptions of their physicians' physical activity behaviours seem to play a role in the decision about whether or not to engage in physical activity. The personal health habits of clinicians can impact their counseling practices, especially regarding physical activity. Patients may be more inclined to exercise if their physician also leads an active lifestyle, and patients' perceptions of their doctor's activity patterns can influence their own decision to engage in physical activity. The close relationship between a physician's personal health practices and their counseling techniques underscores the importance of doctors leading by example in promoting healthy behaviors to their patients.<sup>32</sup>

### **Policymakers Role in Increasing Physical Activity**

Policymakers play an important role in promoting physical activity. Various policies and interventions have been implemented to increase physical activity, including:

- First Lady Michelle Obama's Let's Move! campaign
- Missouri state law designating jumping jacks as the state's official exercise
- Oklahoma's Senate Bill No. 1876, which improved physical education curriculum in schools since 2014
- The Safe Routes to School program, which provides infrastructure such as sidewalks to promote safe walking and biking to school
- Public transportation policies that promote physical activity
- Safe and accessible urban planning that promotes walking, cycling, and other physical activities
- Bike rental services to make active transportation more accessible
- Designing walking and biking paths on campuses
- Providing workplace fitness centers and incentives for employees to be physically active, such as flexible time policies and activity competitions with prizes like pedometers
- Bogota's open streets policy, which prohibits motor vehicles for a specified time to make streets available for physical activity.<sup>40</sup>

In addition to promoting physical activity, it has several health benefits such as improving mental well-being, bone health, physical function, cognitive and executive function, and lowering the risk of falls and falls-related injuries. Physical activity should be enjoyable and pleasurable, so physicians can tailor physical activity programs based on their patients' preferences to increase participation and adherence. Group experiences may be encouraged to establish physical activity habits since they offer emotional safety and social support that foster enjoyment of the activity.<sup>41,42</sup>

### **Resources recommended for reading:**

- Physical activity guidelines for Americans, 2nd

- edition, Department of Health and Human Services, 2018<sup>22</sup>
- WHO guidelines on physical activity and sedentary behaviour, Geneva, WHO, 2020<sup>42</sup>
  - JM Rippe. Integrating Lifestyle Medicine in Cardiovascular Health and Disease Prevention, CRC Press, 2022<sup>27</sup>
  - WHO STEPwise approach to NCD risk factor surveillance. Global physical activity questionnaire (GPAQ), Geneva, WHO, 2021<sup>43</sup>

#### ACRONYMS

ACSM	: American College of Sports Medicine
AHA	: American Heart Association
ATP	: Adenosine Tri- Phosphate
CDC	: Center for Disease Control
CHD	: Coronary heart disease
COX	: Cyclooxygenase
CVD	: Cardiovascular Disease
DALY	: Disability-adjusted life years
ER	: Endoplasmic reticulum
FITTP	: Frequency, intensity, time, type and progression
HSP	: Heat shock proteins
MET	: Metabolic Equivalents
MI	: Myocardial infarction
NEAT	: Non-exercise activity thermogenesis
NO	: Nitric oxide
PAGA	: Physical Activity Guidelines for Americans
PAVS	: Physical Activity Vital Sign
PNF	: Proprioceptive neuromuscular facilitation
QALY	: Quality-adjusted life-years
SAARC	: South Asian Association for Regional Cooperation
SDC	: Sudden cardiac death
YLL	: Years of Life Lost

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