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Exercise is Medicine: From an Aphorism to an Aspirational Global Initiative

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ABSTRACT

Whereas the famous aphorism "Exercise is Medicine" has been attributed to Hippocrates, credence goes to Christobal Mendez for coining the lofty term "Blessed Medicine" for this speciality. With tremendous developments in the field of medicine, the concept of "Exercise is Medicine" has gained renewed importance in addressing modern health challenges, including the global epidemic of physical inactivity with resultant burden of chronic diseases. This article explores the historical perspectives, physiological underpinnings, and contemporary relevance of exercise as a cornerstone of health promotion and disease management. It examines the therapeutic application of tailored exercise prescriptions, and the potential risks of over-exercising. Evidence highlights the transformative power of integrating exercise into routine healthcare practices, requiring a multi-sectoral approach for effective advocacy and implementation.

Keywords: Exercise, Physical Activity, Sedentary Lifestyle, Physical Inactivity, Therapeutic Exercise, Chronic Diseases, Disease Prevention.

INTRODUCTION

"Exercise alone would prevent many of those diseases which cannot be cured and would remove others where medicine proves ineffectual" ..... "of all the causes which conspire to render the life of man short and miserable, none have greater influence than the want of proper Exercise".

William Buchan (1729-1805)- Author of "Domestic Medicine" [1].

Exercise or Physical Exercise is an activity requiring physical effort, carried out to sustain or improve health and fitness. The famous aphorism "Exercise is Medicine" has been attributed to Hippocrates (460 BCE- 370 BCE), Father of Medicine as Rational Science. He was the first "recorded" physician to provide a detailed written exercise prescription of walking for a patient with consumption [2]. In the first book of physiotherapy published in 1553 under the title "Book of Bodily Exercise", the author

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Christobal Mendez (1500-1556), a Spanish physician, advocated "*if we use exercise under the conditions which we will describe, it deserves lofty praise as a "B**lessed Medicine**" that must be kept in high esteem*" [3]. As a result of the historic meeting taking place on November 5, 2007 at Washington DC, jointly sponsored by the American Medical Association (AMA) and the American College of Sports Medicine (ACSM), a global initiative "*with the intent to mobilize physicians and healthcare providers to incorporate exercise in their practices to prevent, reduce, manage, or treat chronic diseases that impact health and the quality of life*" [4]. This review would highlight the growing evidence of preventive, therapeutic and rehabilitative roles of exercise, on individual and community levels.

Objectives:

1. To review the historical perspectives of exercise as a tool for health and well-being.
2. To analyze the global burden of chronic diseases attributed to physical inactivity.
3. To explore the physiological and therapeutic benefits of exercise in disease prevention and management.
4. To provide recommendations for integrating exercise into public health and clinical practice.

METHODOLOGY

A comprehensive literature search was performed on electronic platforms: PubMed, Scopus and Ovid, for publications in English, on adult population, from 2000 to 2025. The exclusion criteria were those with advanced chronic diseases, those with gross physical disabilities and those pregnant.

The following key words, in pairs, were used:

- Exercise AND Medicine
- Exercise AND History
- Exercise AND Physical Inactivity
- Exercise AND Disease Burden
- Exercise AND Physiology
- Exercise AND Nutrition

The results were cumulated to get the final list of citations. Furthermore, the retrieved articles were tracked down looking for other relevant studies or reviews. Medical definitions of the relevant terms: physical activity, physical inactivity, physical exercise, physical fitness, chronic diseases and health promotion were retrieved. Global recommendations for physical activity and recommended physical activity for older adults were made available for potential readers.

The following research questions were formulated and addressed in the ongoing text.

1. What is the Historical Perspective of Exercise?
2. What is the difference between Sedentariness and Physical Activity?
3. What is the disease burden of Physical Inactivity?
4. What is the link between Physical Inactivity and Chronic Diseases?
5. What is the Nutritional Aspect of Regular Physical Exercise?
6. What is Therapeutic Exercise?
7. What is Prescriptive Exercise?
8. What is Overexercising/ Overtraining Syndrome?
9. What are the Potential Risks of Exercise?

Definitions

- Physical activity (PA) has been defined as "any bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure" [CDC].
- Physical inactivity has been defined as: "failure to accumulate at least 150 minutes of moderate physical activity or 75 minutes of vigorous physical activity or the combination of both intensities per week"" [WHO]
- Physical Exercise, a subset of physical activity, has been defined as: "a type of physical activity that involves planned, structured, and repetitive bodily movement done to maintain or improve one or more components of physical fitness" [CDC].
- Physical Fitness is "a set of attributes that people have or achieve relating to their ability to perform physical activity. The health-related components of physical fitness include the following: (1) body composition, (2) cardiovascular endurance, (3) flexibility, (4) muscular endurance, and (5) muscular strength". [CDC]
- Chronic Diseases, also known as Noncommunicable diseases (NCDs) "tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavioral factors. [WHO]. They last 1 year or more and require ongoing medical attention or limit activities of daily living or both" .[CDC].
- Health Promotion is "the process of enabling people to increase control over, and to improve, their health. It moves beyond a focus on individual behavior towards a wide range of social and environmental interventions" [WHO]

Global recommendations for Physical activity

- At least 150 minutes of moderate-intensity physical activity throughout the week, or at least 75 minutes of vigorous-intensity physical activity, or an equivalent combination of both.
- For additional health benefits, increase moderate-intensity physical activity to 300 minutes per week, or equivalent.
- Muscle-strengthening activities should be done involving major muscle groups, 2 or more days a week [WHO]

Recommended Physical Activity for Older Adults

Every week, adults 65 and older need physical activities that include:

- At least 150 minutes (for example, 30 minutes a day on 5 days a week, or 22 minutes a day) of moderate-intensity aerobic activity, such as brisk walking. Or 75 minutes a week of vigorous-intensity aerobic activity, such as hiking, jogging, or running. Or this can be an equivalent mix of moderate- and vigorous-intensity aerobic activity.
- At least 2 days of activities that strengthen muscles.
- Activities to improve balance, such as standing on one foot. [CDC]

RESULTS

As a narrative review, the manuscript does not have conventional "results" because no quality evaluation was performed. The numerous thematic sections have been concisely summarized.

Historical Perspectives: Past and Present

"The notion that exercise is important for well-being, health, and longevity has been documented throughout history and all over the world" [5].

The history of association of physical exercise with medicine is long and venerable spreading over centuries, with remarkable contribution from China, India and Greece. Following is just a glimpse of that fascinating tale.

(a)- Ancient Era

China, from 2500-250 BCE, founded some fitness practices that are still in use. Qigong (pronounced "chi-gong") an ancient Chinese system of physical exercise and meditation that combines movement, breathing, and mental concentration, was developed in China thousands of years ago, as part of traditional Chinese medicine. Believing that one should always keep the body in the best condition possible, Confucius (551 BCE- 479 BCE), the famous Chinese philosopher, encouraged his people to participate in regular physical activity [6]. It was generally agreed that physical inactivity was associated with a variety of different diseases (referred to as organ malfunctions and internal stoppages, which sound similar to heart disease and diabetes) were preventable with regular physical exercise. In addition to Cong Fu gymnastics (devised to keep the body in optimal working condition) other forms of physical activity were introduced including wrestling, dancing and archery [7].

Sushruta (c800 BCE-c700 BCE), author of the Sushruta Samhita (Sushruta's Compendium), a treatise considered to be one of the most important surviving ancient treatises on Ayurvedic Medicine, was the first known physician to prescribe exercise for his patients. He was of the view that "*diseases fly from the presence of a person habituated to regular physical exercise*" [8].

The practice of physical exercise was regarded by the citizens of Greece as a national duty, with established gymnasiums, during the time of Homer (fl. 750 BCE) [9]. The ancient quadrennial Greek athletic festivals of mighty nation, designed to pay tribute to the nation's manhood and honor its gods, were first recorded reliably in 726 BCE. Interestingly, the games were open to all spectators except married women [10].

Renowned Greek physician Herodicus (fl. 5 century BCE), justifiably called the "Father of Sports Medicine", is the first person in the history of medicine to whom the first use of therapeutic exercise for treatment of disease and maintenance of health is credited [11]. He advocated exercise as an important and effective tool in physical rehabilitation following sports trauma. Hippocrates further strengthened this practice [12] Herophilus (335- 280 BCE), the founder of the earliest medical school in Alexandria, Erasistrasus (304-250 BCE) anatomist and physician, and Asclepiades of Bithynia (circa125-40 BCE), pioneer of music therapy, prescribed moderate exercise (including walking and running) to the injured athletes as a part of rehabilitation process. Pythagoras (570–490 BCE) was the first medical philosopher from ancient Greece to advocate daily exercise two times (morning and bedtime) for health reasons [9].

While negating physical inactivity and promoting physical activity, Hippocrates advocated :"*In a word, all parts of the body which were made for active use, if moderately used and exercised at the labor to which they are habituated, become healthy, increase in bulk, and bear their age well, but when not used, and when left without exercise, they become diseased, their growth is arrested, and they soon become old*" [13].In a motivational message, renowned Greek philosopher Socrates (c 470-399BCE) said "*No man has the right to be an amateur in the matter of physical training. It is a shame for a man to grow old without seeing the beauty and strength of which his body is capable*."

Galen (129-199 AD), famous Greek physician, further elaborated the role of exercise in convalescence and surgery. It was during his era that exercise was prescribed for multiple diseases to minimize their consequences [5].

(b)— Modern Era

The views of giants in medicine are valuable. Prof. James William White (1850-1916), from Philadelphia, in 1887 wrote:

''*Let it be understood that the main object and idea of exercise is the acquirement or preservation of health; that it is by far the most important therapeutic and hygienic agency at the command of the physician of today; that it can be prescribed on as rational a basis with as distinct reference to the correction of existing troubles or the prevention of threatened ones as any of the drugs of the pharmacopeia*'' [14].

In 1907, Dr. Theodore Toepel (1870-1943), widely known as Atlanta physician and advocate of physical education, wrote: "*Very few physicians who recommend "physical exercise" as a therapeutic measure have any idea of dosage and physiological limits of the work*" [15].

Credit goes to the optimism of Peter Karpovich (1896-1975), author of "Physiology of Muscular Activity" who wrote in 1968: "*there is growing evidence on the preventive value of exercise, and it is possible that, in the not too distance future, physical education will become a part of medicine*" [16].

The "Exercise is Medicine" initiative began in the 1990s, based on a prospective study published in 1989 demonstrating a clear link between low physical fitness levels and an increased risk of all-cause mortality, including cardiovascular diseases and cancers [17].

A historic meeting took place on November 5, 2007 at the National Press Club in Washington, D.C. It was jointly sponsored by the American Medical Association (AMA) and the American College of Sports Medicine (ACSM). The organizations were represented by Ronald0 Davis (President AMA) and Robert Sallis (President ACSM) respectively. Also in attendance were Rear Admiral Steven Galson, the Acting Surgeon General along with Melissa Johnson (Executive Director of the President's Council on Physical Fitness and Sports), and Jake Steinfeld (Chairman of the California Governor's Council for Physical Fitness and Sports).

Sallis explained to the reporters that ''*if we had a pill that conferred all the proven health benefits of exercise, physicians would widely prescribe it to their patients and our healthcare system would see to it that every patient had access to this wonder drug*.'' Similarly, Davis asked his colleagues if they "*learned that a single prescription could prevent and treat dozens of diseases, such as diabetes, hypertension, and obesity, would you prescribe it to your patients?*" Galson advocated that "*the practice of engaging in regular physical activity is*

one which must be adopted broadly by individuals and families everywhere if we, as a nation, are to make truly sustained progress in health promotion". Undoubtedly, this was the start of a new era.

However, the credence that exercise is medicine, or part of medicine, is not new. Berryman, the Exercise Science Historian, advocates that the strong emphasis on health, rather than disease, dates back to the two most prominent physicians of the ancient world: Hippocrates (460 BCE-370 BCE) and Galen (129 AD—210 AD) [4].

After the historic launching of EIM Initiative in United States on November 5,2007, individual countries also started realizing the magnitude of the problem of physical-inactivity related diseases. Currently, there are EIM National Centers in 37 countries on 6 continents (North America, South America, Asia, Europe, Africa, and Australia), with 3 EIM Regional Centers in Asia, Latin America, and Europe [18].

Dr Fiona Bull, Head of the WHO Unit for Physical Activity, while making the situation analysis of the growing issue of physical inactivity commented as: "*Promoting physical activity goes beyond promoting individual lifestyle choice - it will require a whole-of-society approach and creating environments that make it easier and safer for everyone to be more active in ways they enjoy to reap the many health benefits of regular physical activity*" [19].

Establishing consensus on 'what works'to change physical activity behavior is a cornerstone of successful advocacy. The International Society for Physical Activity and Health identified the healthcare sector as one of the eight best investments to combat global population inactivity [20].

"The new WHO's Global Action Plan on Physical Activity 2018–2030: More Active People for a Healthier World" responds to the requests by countries for updated guidance, and a framework of effective and feasible policy actions to increase physical activity at all levels. It needs all people being regularly active, according to ability and across the life course [21].

In US, The Centers for Disease Control and Prevention (CDC) developed "CDC's Active People, Healthy Nation SM: Creating an Active America, together"-an aspirational initiative to improve physical activity in 2.5 million high school youth and 25 million adults, doubling the 10-year improvement targets of Healthy People 2020 [22].

Difference between Sedentariness and Physical Inactivity

"The slow rhythm of the body, the insistent rhythm of the wit, were they becoming irreconcilable in modern civilization? The sedentary life, frustration and irritability; work with the body, fatigue - and peace of mind".

Henry Williamson (1895-1977)—English Writer

Sedentary comes from the Latin term "sedere," which means "to sit." Contrary to commonly understood, sedentary behavior is not a synonym for physical inactivity. Currently, the terminology consensus project from the Sedentary Behavior Research Network (SBRN) defines sedentary behavior as "*any waking behavior characterized by an energy expenditure ≤ 1.5 METs, while in a sitting, reclining or lying posture.*" [23].

This definition excludes a standing position as sedentary behavior and grants a better understanding of what sedentary behaviors are, and what differentiates them from others. Some examples of sedentary behavior include television viewing, playing video games, using a computer, sitting at school or work, and sitting while commuting [24].

According to the 2011 Compendium of Physical Activities, MET is defined as the ratio of work metabolic rate to the standard resting metabolic rate (RMR) of 1 kcal/(kg/h). One MET is the RMR or energy cost for a person at rest. When classified quantitatively based on their intensities, physical activities can be classified into 1.0–1.5 METs (sedentary behavior), 1.6–2.9 METs (light intensity), 3–5.9 (moderate intensity), and ≥6 METs (vigorous intensity) [25].

Disease Burden of Physical Inactivity

"According to the estimates of WHO in 2022, nearly one third (31%) of adults worldwide, approximately 1.8 billion people, did not meet the recommended levels of physical activity".

WHO Fact Sheet released on June 26,2024 [26]

According to a study conducted by researchers from WHO together with academic colleagues and published in The Lancet Global Health Journal "National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: a pooled analysis of 507 population-based surveys with 5·7 million participants", the worrying trend of physical inactivity among adults, has increased by about 5 % points between 2010 and 2022, the levels of inactivity are projected to further rise to 35% by 2030 [27]. It is a melancholic reality that, in some countries, levels of inactivity can be as high as

70%, due to changing patterns of transportation, increased use of technology and urbanization [21]. If this trend continues, the proportion of adults not meeting recommended levels of physical activity is projected to rise to 35% by 2030 [21].

Whereas physical inactivity, a silent threat to global health, is a principal contributor to the global burden of chronic disease, the global target set to reduce levels of physical inactivity in adults and adolescents is a 10% relative reduction by 2025 and 15% by 2030, from the 2010 baseline [19].

The old belief "Exercise Prolongs Life" is certainly untrue but what is true and must be true is that exercise does improve the quality of life and delays onset of aging. It was with this understanding that regular exercise, in the form of daily work, was an important part of life before the industrial age. With the advent of the modern time saving mechanical age, people adopted a sedentary attitude forgetting the teaching of Plato (429 BCE-347 BCE): "*And is not bodily habit spoiled by rest and idleness but preserved for a long time by motion and exercise*" [28].

The global estimate of the cost of physical inactivity to public health care systems between 2020 and 2030 is about US$ 300 billion (approximately US$ 27 billion per year) if levels of physical inactivity are not reduced [26].

Link between Physical Inactivity and Chronic Disease

"*A sedentary lifestyle during adulthood, which is often the result of a childhood with restricted physical activity, may contribute to the development of various illnesses collectively classified as hypo-kinetic diseases (coronary heart disease, obesity, diabetes, hypertension, colon cancer, and low back problems)*"

Alan Morton——[29]

Physical inactivity, which Blair has termed as the "biggest" public health problem of the 21st century [30], is a principal contributor to the global burden of chronic diseases. According to the WHO, it is the fourth greatest risk factor for mortality, attributed to approximately five million preventable deaths, per year [26].

Currently, some 50% of the US population has a chronic disease consuming 86% of health care expenditure [31].

Whereas lifestyle factors are a major cause of the costly burden of chronic diseases, physical activity is a key component in achieving a healthy lifestyle and reducing the burden of many serious diseases which are mostly preventable. Lee is right in concluding that "*physical activity, while not a drug, can behave like one*" [32]. It has been estimated that over 35 chronic conditions, many of which are within the cardiovascular spectrum, are preventable by right dose physical activity [33]. According to Sallis, *"the exercise is viewed as a cost effective medication that is universally prescribed as a first line treatment for virtually every chronic disease*" [34].

Obesity is the most common and significant health issue associated with physical inactivity [35]. It is the root cause of many chronic diseases. Obesity, particularly visceral adiposity, adversely interacts with physical inactivity to further increased risk of CHD and type 2 diabetes mellitus, which itself is an important risk factor for CHD [36].

In Type 2 diabetes(T2DM) physical activity has a preventive, therapeutic, rehabilitative, and psychological role to play. According to the Joint Position Statement of the American College of Sports Medicine (ACSM) and the American Diabetes Association (ADA), participation in regular physical activity improves blood glucose control and can prevent or delay onset of T2DM [37].

The findings of metaanalysis of 10 cohort studies show that adherence to physical activities of moderate intensity such as brisk walking can substantially reduce the risk of T2DM [38].

A population-based cohort Chinese study provided compelling evidence of a pivotal role of physical activity in mitigating the occurrence of T2DM among individuals classified as pre-diabetes, based on fasting blood glucose criteria [39].

In a systemic review with meta-analysis on the effects of physical activity on pre-diabetes, it was inferred that physical activity helps to slow down the progression of disease by a favorable effect on improving oral glucose tolerance, fasting blood sugar, HbA1C, maximum oxygen uptake (VO2 max), and body composition [40]. Exercise training, whether aerobic or resistance or a combination, facilitates improved glucose regulation [41].

Gabriel and Zierath, while ratifying "The Limits of Exercise Physiology: From Performance to Health" inferred that the acute effects of exercise include enhanced glucose metabolism and improved insulin sensitivity. Such an activity regulates blood glucose levels in those with insulin resistance [42].

Prospective cohort studies show that regular aerobic activity and short-term exercise programs confer a reduced risk of functional limitations and disability in older age [43].

Exercise has psychological benefits for those with T2DM. Increased physical activity and physical fitness can reduce symptoms of depression and improve health-related QoL in those with type 2 diabetes. *[ACSM Evidence-Category B]."*

With the background knowledge that physical activity has been inversely associated with risk of several cancers, a systematic review and meta-analysis was performed to evaluate the association between physical activity and risk of esophageal cancer particularly esophageal adenocarcinoma. It was demonstrated that the risk of esophageal cancer was 29% lower among the most physically active compared to the least physically active subjects [44]. Although an inverse association between physical activity and risk of colon cancer, in both men and women, is well established [45], a significant inverse association was found to exist between physical activity, including that of moderate intensity, such as walking, and risk of colon cancer in women that is more pronounced for distal tumors [46]. A meta-analysis examining 52 studies, concluded that there was an estimated 24% risk reduction for colon cancer in men and women who walk approximately 5 to 6 hours per week [45].

Persons with mild cognitive impairment are at increased risk for developing dementia or Alzheimer's disease (AD) when compared with similarly aged individuals in the general population [47]. In a systematic review and meta-analysis, physical activity was associated with lower incidence of all-cause dementia and Alzheimer's disease, even in longer follow-ups, supporting physical activity as a modifiable protective lifestyle factor, even after reducing the effects of reverse causation [48].

Booth' s statement is a guideline for all those practicing in all the specialties of medicine: "*Physical activity primarily prevents, or delays, chronic diseases, implying that chronic disease need not be an inevitable outcome during life*" [33]. It would be in the fitness of the things to add right dose of physical activity in the medical management of a chronic disease, once diagnosed [49].

Nutritional aspects of Regular Physical Exercise

"*Food and exercise, while possessing opposite qualities, yet work together to produce health*" [12].

What is the relationship between diet and physical exercise? There is an undeniable relationship between food and exercise. Whereas our energy is sourced from a balanced plate of food, the exercise burns energy. The more physically active a person is, the higher the energy intake without the worry of obesity. Without the nutritious food, the fuel of our body, physical fitness cannot be achieved. The higher energy intake will better ensure an adequate intake of essential nutrients. As the age advances, there is a gradual reduction in the BMR but no proportional reduction of the demand for essential nutrients. This is why old people need to stay physically active. In the treatment of obese patients, it is essential to combine a recommendation of restriction of energy intake with an increase in energy output by daily physical activity [43].

To sum up, eating a balanced diet and being physically fit are two important components of a sound body and mind.

Therapeutic Exercise

"*Recovery Is Not A Race. You Don't Have To Feel Guilty If It Takes Longer Than You Thought It Would.*" — Anonymous

In the simplest terms, therapeutic exercise involves movement prescribed to correct impairments, restore muscular and skeletal function and/or maintain a state of well-being [50].

Ryan and Allman, in 1974, defined therapeutic exercise as "*bodily movements prescribed to restore or alter favorably specific functions in an individual, following an injury* [10]. Therapeutic exercise is one of the tools physical therapists commonly use during patient rehabilitation for various issues, including postoperative care, common orthopedic injuries, and conditions of a specific body part or joint, or as part of recovery from a sports injury.

The types of therapeutic exercise include:

1. Strengthening (training exercises to rebuild muscle tissue in the targeted area)
2. Endurance (training exercises performed for longer durations involving more gross overall muscle movements)
3. Balance and coordination (exercises go hand in hand to improve posture and promote joint stability). At times, this type of exercise can be referred to as neuromuscular re-education because it directly affects the interactions of the neural and muscular systems).
4. Flexibility (exercises help to loosen muscles and improve range of motion) [51].

Additionally, therapeutic importance of physical exercise

has been shown in neuroplasticity which is an essential mechanism by which the nervous system shapes and adapts according to functional requirements. In a Portuguese study, it has been found that moderate to high intensity aerobic exercise induces neuroplasticity in neurological patients, thus being a fundamental therapeutic strategy to include in interventions aiming to repair/delay neurological dysfunctions [52].

Over exercising: Other Side of the Coin

"Participation in strenuous exercise or heavy physical activity, would cause multiple diseases and potentially lead to death".

Sushruta (c800 BCE-c700 BCE) - Father of Indian Medicine

About 3 millennia ago, Sushruta, from the Indus Valley civilization, was the first known physician to prescribe moderate daily exercise for his patients. His advocacy was: "physical exercise should be taken every day" but taken "only to half extent of his capacity" as otherwise "it may prove fatal" [8]. Over-exercising is when one does more exercise than his body can handle. This includes doing too much exercise or exercising in an unsafe way, or not eating enough food alongside exercising. The etiology is multifactorial: engaged in a competition, over- dependence on exercise ("more the better"), misinformation about exercise (not tailored to individual needs), stigma about body figure and weight and as part of a mental health problem, notably self-harm. Exercise addiction is a type of over-exercising, when one feels a lack of control over how much exercise he can do, as part of an eating problem or body dysmorphic disorder (BDD).

Overtraining syndrome (OTS) is a complex clinical disorder that occurs across occupations that demand intensive physical and emotional input in exchange for performance – most prominently amongst the elite athletic population. [53].

It is a medical condition that happens when one exercises too often or too intensely for long enough that it starts to hurt his body. It causes physical, mental and emotional symptoms. Recovery can take weeks to months [54].

Prescriptive Exercise

"By promoting the right "dosage" of physical activity, you are prescribing a highly effective "drug" to your patients for the prevention, treatment, and management of more than 40 of the most common chronic health conditions encountered in primary practice".

Action Guide — [55]

Prescriptive exercise is physical activity focused on a specific therapeutic goal in the same way that a medication treats a specific disease or symptom. The exercise program may also include behavior modification to ensure long-term compliance to obtain the specific goals. Just like medication prescription, the exercise prescription should be individualized. Ideally, it should be enjoyable, affordable, and achievable, fitting the time schedule of the patient to encourage adherence.

The first and foremost pre-requisite is to ratify the willingness and readiness of the individual for an Individualized Exercise Program. Exercise here is defined as "*a broad range of activities intended to improve strength, range of motion (including muscle length), cardiovascular fitness, flexibility, or to otherwise increase a person's functional capacity*" [56]. Undoubtedly, the evidence for the benefits of regular exercise in the prevention and treatment of disease is irrefutable but here the issue is of an individual who is, in most cases, sedentary in habits. He needs to be convinced and motivated towards a change in his lifestyle. John Heywood (c. 1497 – c. 1580) -English Play-writer was realistic in his statement "*You can lead a horse to water, but you cannot make it drink*". We could proceed further only if the attitude of the individual is positive, and he is convinced that the proposed physical activity program is beneficial for him.

Step 1— Taking an Accurate Exercise History

It is a must that the patient is enquired about the reasons of his sedentary habits and the unique barriers preventing him from being active in the past. In most cases these can be manageable by mutual discussions and offering practical alternatives.

Step 2—Assessing the Physical Activity Level of the individual

This can be done by taking personal information from the patient. What is your job? How long do you spend sitting at work? What activities you are required to do at your workplace? Additionally, by making use of the Physical Activity Vital Sign (PAVS) – a tool first implemented in clinical practice in 2010 in the Kaiser Permanente Healthcare System in California. It consists of two questions:

1. On average, how many days per week do you engage in moderate to strenuous exercise like a brisk walk?
2. On average, how many minutes do you engage in exercise at this level? [55]

Step 3 - Safety Screening

This is done by determining the competency of the patient to be healthy enough to exercise independently. Shusruta's advice, although >3 millennia ago, "*essential for the physician to consider the age, strength, physique, exercise terrain, and diet of the patient*" is still fresh. The level of assessment would be proportionate to the level of proposed physical activity (aerobic activities, resistance training and balance/ proprioceptive exercises) and the perceived risk of both cardiovascular event and musculoskeletal injury.

The four principles on which the exercise prescription is based are: Frequency, Intensity, Time, Type, collectively called FITT which is "*the process whereby the recommended exercise regimen is designed in a systematic and individualized manner*" [55].

1. **Frequency:** number of sessions per week. For sedentary individuals, start with 2-3 days/week of aerobic exercise and build up to 5 days/week.
2. **Intensity:** How hard to exert: perceived exertion e.g relative to walking, the 'talk-sing test' or heart rate data? To estimate maximum age-related heart rate, the patient's age should be subtracted from 220. [57]. Ideally, start with low intensity for beginners and increase gradually. It is possible to classify the physical activity based on light, moderate, or vigorous intensity through the MET unit which corresponds to the energy required by an individual to keep at rest, representing an oxygen uptake of ~3.5 mL/kg/min [58].
3. **Timing:** duration of sessions which must include a prolonged warm-up and exercise adaptation period and time allowance for adequate cool-down.
4. **Type:** refers to mode of exercise training with main forms being aerobic (i.e. endurance training), resistance (i.e. strength training), flexibility, and balance. In making preferences, the physical medicine professional must consider fitness level, fitness goals, exercise preferences, equipment availability, and other personal factors that may impact participation [55]. It has been shown that a few minutes of flexibility exercise when combined with aerobic and strength training is a complete regime that will benefit the body.

Moderate exercise raises the heart and respiration rates, and it is recommended that one should be "able to talk but not sing a song" when exercising at the appropriate intensity. In cases of limited physical mobility (e.g. arthritis) or reduced fitness (e.g. cardiac problems) the elderly may not be able to stick to a regular exercise program. Moreover, Post Exercise Hypotension (PEH), resulting in an immediate substantial reduction in BP, could also pose a serious problem in some cases. A Supervised Physical Exercise Program (SPEP) has given promising results in those with such problems, as noted in a Brazilian study [59].

The guidelines of Clinical Exercise Physiology Association (CEP) could be incorporated in the SPEP. They focus on the improvement of physical capabilities for the purpose of: (1) chronic disease management; (2) reducing risks for early development or recurrence of chronic diseases; (3) creating lifestyle habits that promote enhancement of health; (4) facilitating the elimination of barriers to habitual lifestyle changes through goal-setting and prioritizing; (5) improving the ease of daily living activities; (6) and increasing the likelihood of long-term physical, social and economic independence [60].

Exercise training or the "chronic exercise" intervention can be defined as a repeated amounts of bouts of exercise during a short or long-term period while, the "acute exercise" can be defined as a single bout of exercise [61].

Potential Risks of Exercise

"While there are potential risks associated with exercise, these can be minimized with a proper approach and are far outweighed by the benefits".

Robert Sallis -President ACSM [34]

The beneficial effects of physical exercise are well established. However, it may also pose as a risk factor for health under specific circumstances. According to Lee, "*it is plausible that there is a minimum dose of physical activity for health benefits, that these benefits increase with increasing dose, and that beyond a certain dose, adverse effects outweigh benefits*'' [32]

Whereas the most serious inherent risk of exercise is a cardiac event, the most common injuries sustained are to the musculoskeletal system [62]. Increased shortness of breath, muscle cramps and soreness have been reported, especially at the beginning of physical activity interventions. Dyspnea in those with COPD can result in worsening breathlessness due to deconditioning [63] and resultant progressive avoidance of physical activity. Hypoglycemia in those diabetics, though rare,

may pose difficulty at times. Primarily, the risks connected with exercise are physical risks, but also psychological risks may appear, especially when exercise is conducted excessively. Psychological risks include eating disorders, illegal and legal substance use and exercise dependence. [64].

Whereas the benefits of physical activity for people living with long-term conditions (LTCs) are well proven, the risk of exacerbating symptoms and causing adverse events is a persuasive barrier to physical activity in this population. Based on a consensus statement, Hamish Reid Paul Kelly group has concluded that for people living with stable LTCs, the far-reaching benefits of physical activity outweigh associated risks [65]. It has been noted that the undesired side effects of injuries, dehydration and cardiac arrest are amplified when untrained or previously sedentary persons undertake vigorous exertion suddenly [66]. These issues are manageable with individualized exercise prescription. A tailored exercise plan, under well-qualified medical supervision, is essential to mitigate these risks and maximize the benefits of physical activity [67].

DISCUSSION

"Lack of activity destroys the good condition of every human being, while movement and methodical physical exercise save it and preserve it." –

Plato (c428-348 BCE)—Foundational thinker

Exercise is not just a lifestyle choice; it is a fundamental pillar of health and well-being, deeply rooted in human biology. From ancient civilizations to modern medicine, the value of physical activity has been extolled as both a preventive and therapeutic tool. In the face of a global epidemic of chronic diseases driven by sedentary lifestyles, the mantra "Exercise is Medicine" carries profound meaning.

Prescribing exercise as a critical intervention for the prevention, management, and even reversal of many chronic conditions, including cardiovascular disease, diabetes, obesity, depression, and certain cancers is the moral duty of every healthcare provider.

The physiological benefits of exercise are vast and well-documented. Regular physical activity enhances cardiovascular health, improves insulin sensitivity, regulates body weight, strengthens musculoskeletal structures, and boosts mental health by reducing stress and improving mood. Moreover, the systemic anti-inflammatory and immune-modulating effects of exercise provide protective mechanisms against a range of chronic diseases. Beyond these physiological benefits, the psychological and social impacts of regular exercise, such as improved self-esteem, social engagement, and cognitive function, further highlight its role in holistic health.

Yet, despite the overwhelming benefits of physical activity, physical inactivity remains alarmingly prevalent. This paradox underscores the urgent need for systemic change, from public health policies to healthcare practices. Sedentary behavior, distinct from physical inactivity, compounds the risk, with prolonged periods of sitting or minimal movement being linked to metabolic and cardiovascular dysfunction. Addressing this "sitting disease" requires awareness campaigns and structural changes in workplaces, schools, and urban planning to promote movement throughout the day.

Exercise, however, is not without risks. The advent of extreme fitness regimens and the culture of over-exercising among certain populations can lead to overuse injuries, burnout, and in rare cases, life-threatening complications such as arrhythmias in predisposed individuals. This emphasizes the importance of tailored exercise prescriptions. Exercise must be individualized, considering the person's health status, goals, and limitations. Physicians and allied healthcare professionals have a crucial role in bridging the gap between evidence and practice, incorporating exercise counseling into routine care.

Ultimately, the global burden of chronic diseases is not just a healthcare crisis but a societal one. Physical activity, as a modifiable risk factor, provides an accessible and cost-effective solution. However, the path forward requires more than individual commitment. Governments, healthcare systems, communities, and workplaces must collaborate to create environments that prioritize and facilitate movement. Integrating exercise into daily life must become a societal norm, supported by public health policies, healthcare advocacy, and cultural shifts.

CONCLUSION

"Movement is a medicine for creating change in a person's physical, emotional, and mental states." –

Carol Welch— Emotional Therapeutic Counselor

In the first book of physiotherapy published in 1553 under the title "Book of Bodily Exercise", the author Christobal Mendez (1500-1556), a Spanish physician, advocated *"if*

*we use exercise under the conditions which we will describe, it deserves lofty praise as a "**blessed medicine**" that must be kept in high esteem*" [3]. Recognizing exercise as "**Blessed Medicine**" challenges us to rethink the traditional healthcare paradigm. It calls for a preventive approach that empowers individuals to take charge of their health through movement. By embedding physical activity into education, healthcare, and public health strategies, we can mitigate the profound impact of sedentary lifestyles on individuals and society. Exercise, when embraced as a cornerstone of health, has the potential to transform lives, enhance longevity, and reduce the global burden of disease. This is not merely a medical mandate but a societal imperative. The fitting closing sentence would be the quote of Ibn Sina (980-1037), —- "***Physical activity can replace many drugs, but no drug can ever replace physical activity***".

AUTHORS CONTRIBUTION

The authors made substantial contributions to the conception and design of the study, acquisition of data, analysis, and interpretation of data, drafting the article, revising it critically for important intellectual content, and final approval of the version to be submitted.

ETHICAL APPROVAL

The authors declare that conducted research is not related to either human or animals use.

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CONFLICT OF INTEREST

The authors disclose no conflict of interest related to the present study.

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