

Special Article – Cardiovascular Rehabilitation

Exercise in Health and Disease: Overview of Contributions and Challenges

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A brief review of the literature on exercise in achieving health benefits and evolution of sedentary behavior is provided. The contributions of programmed exercise activities for proven benefits (life expectancy, cardiac rehabilitation, hypertension, obesity) and limitations in the identification of those benefits when multiple morbid conditions co-exist are discussed. A summary discussion of the effects of aerobic, dynamic and isometric resistance exercise modalities in blood pressure control and congestive heart failure underscores their favorable contributions.

Keywords: Healthy physical activity; Sedentary behavior; Cardiac rehabilitation; Hypertension; Obesity

Introduction

The benefits of physical activity are known since humans have been able to keep written historical records (Chinese early Han dynasties, 2,600 years AC; Classic Greek era, 350 years AC). It has not been understood how and to what extent this beneficial influence operates within many conditions until the middle of last century with the pioneering work of Morris and Paffenbarger [1-3].

However, physical inactivity is just one of the many risk factors underlying the onset and progression of diseases (unhealthy diet, smoking, stress, poverty, to name a few). The impact of exercise with or without the interaction of these other risk factors, both in observational cohorts and rigorous prospective trials, are the focus of many scientific centers and researchers. Furthermore, the therapeutic use of exercise for established disease processes, especially cardiovascular, have become more important in the last 30 years.

Evolution to a Sedentary Behavior

Sedentary life style is usually described as the lack of sufficient physical activities in daily life [4,5]. However, the origin of this word (from the Latin “sedere”, or the action of sitting down) was intended more as a description of the process in which human groups transitioned from the hunting-gathering subsistence, that required a rather nomadic life style in search of food, to a more established organization where food was procured through cultivation and domestication of wild species and animals. It is conceivable that in most cases hunting-gathering required a higher energy expenditure than farming, but mostly the evolution of the established social groups that cultivated the land to the advanced mechanization of labor and food supply of today’s industrial societies has led to a progressive reduction of the opportunities for daily energy expenditures, and increasing consumption of energy enriched foodstuff [4-7].

Exercise and Health Outcomes

Most of the quantitative and quality data related to exercise and its associated health outcomes are in the cardiovascular field, specifically, cardiac rehabilitation after open-heart surgery or acute myocardial infarction [8,9,10]. In a meta-analysis of 22 studies of post acute myocardial patients who received supervised aerobic exercise, prior to the introduction of statins, there was a 25% reduction of cardiovascular mortality after 36 months of follow-up [8]. More recently, several studies, including a large meta-analysis of randomized cardiac rehabilitation studies, showed a significant reduction of mortality and recurrent myocardial infarction [9,10]. Furthermore, exercise as a factor in preventing a plethora of disparate diseases has been documented. Favorable outcomes of physical activity in the management of hypertension [11-14] congestive heart failure [15,16] obesity and related conditions (diabetes mellitus, metabolic syndrome) [17-19], life expectancy and all cause mortality [17,20,21], the prevention of some types of cancer (colon, rectal, ovarian) [22,23], improvement of cognitive functions and emotional disorders have been reported in multiple observational studies [24,25].

How Much Exercise is Needed for Health Benefits?

It is generally accepted that aerobic exercise at a moderate-intensity (40–70% VO₂max) level for 30 minute most days of the week is associated with majority of beneficial effects [26,27]. This level of exercise is achieved by walking at a moderate pace and represents an approximate caloric expenditure of 150kcal (10-14% of the daily normal caloric consumption). For instance walking at that level 5-7 times a week has shown a significant reduction of blood pressure in hypertensive and normotensive participants regardless of their weight [17]. In contrast, exercise intensity over 70% VO₂max has shown no predictable additional reduction on blood pressure.

It has been suggested, likely based on those energy requirements of walking at a moderate pace, that utilizing <10% of the daily energy expenditure in free time activities ("leisure time") is equivalent to sedentary behavior, with estimates of prevalence ranging from 84% in men and 89% in women [20,21,26,27]. The competitive influence of the current encroaching sedentary lifestyle imposed by daily TV watching, desk jobs, computer work and little time left for leisure time limits the opportunities for frequent weekly physical activities [22]. A study done in older adults measuring directly the daily energy expenditure attributable to physical activities using radioactively double labeled water (after subtracting the energy related to the basal metabolic rate) showed that the largest level was achieved by those engaged in some form of physical work and who frequently used stairs. In these individuals the risk of all cause mortality after an average of 6.1 years of follow up was 12.0% in the highest tertile of energy expenditure (> 770kcal/day), 17.8% in the middle, and 24.7% in the lowest tertile (<521kcal/day) [28]. Furthermore, three landmark studies have long supported this concept of total energy expenditure in physical activities as a key factor in cardiovascular health outcomes [2,3,29].

What Type of Exercise?

Most of the comparative data on cardiovascular clinical outcomes associated to the modality of exercise has been published on blood pressure responses of normal and hypertensive individuals [11-14]. A recent meta analysis concluded that aerobic (endurance), dynamic and isometric resistance exercises achieved similar blood pressure results in long term programs, with reductions of systolic blood pressure ranging from 4-8 mm/Hg in hypertensive and 2-4 mm/Hg in normotensive individuals [11].

More recently, several publications have addressed the role of exercise in the management of outpatient CHF patients [15,16]. In CHF most of the published data is limited to aerobic (walking, cycling) activities although some favorable dynamic resistance results have been reported [15,16]. It is important to consider individual preferences and limitations in recommending some of the exercise modalities. Dynamic and isometric resistance exercises alone or in combination with aerobic modalities may be preferred by some individuals or advisable in those with muscular-skeletal limitations or handicaps.

Sedentary Habits and Weight Gain

Several studies have analyzed the relation between sedentary behavior and weight gain and found that longer TV watching times were associated to weight gain and obesity [4,5]. In contrast, other researchers by monitoring varying markers of sedentary behavior (TV watching, time sitting at work, computer time, lack of walking) were unable to predict the future development of weight gain or obesity; although overweight at baseline was predictive of future sedentary life style. [30]. Weight gain is mostly determined by the imbalance between the calorie intake and energy physical expenditure. Although exercise may assist in reducing weight, its influence alone is limited. However, the beneficial health effects of exercise in overweight and obese individuals have been well documented regardless of weight loss. A study done looking at the influence of exercise in the years of life lost by overweight and obesity showed that a significant gain

in life expectancy was achieved by increasing levels of exercise energy expenditures [17]. Another study measuring the vasodilatory response and number of progenitor endothelial circulating cells induced by daily physical energy expenditure showed a greater vasodilatory response and number of circulating cells in those with the highest level of total daily activity independently of the exercise intensity (vigorous exercise was responsible for < than 10% of the total energy expenditure) [31].

Difficulties in Translating the Benefits of Exercise in Clinical Settings

The benefits of exercise alone on cardiovascular outcomes are not so clearly evident when it comes to real world clinical settings, especially in vulnerable populations with co-morbid conditions, due to the multifactorial nature of these health outcomes. One of many examples illustrating the difficulty in assessing physical activity benefits in clinical settings is a study of 509 hypertensive patients in a metropolitan, nationally sponsored primary care clinic in Chile that provides free access to medical care and drug therapy. Weekly energy expenditure was evaluated using a validated IPAQ (International Physical Activity Questionnaire), in this population where two thirds were obese, and one-third had diagnosed diabetes. A total average weekly energy expenditure of 9,291 kcal was recorded in working men, 72% corresponded to work activities and 14.6% to leisure time [32]. Although the level of physical activities as well as medical care were above expectations in this group of low-income patients (a 2010 National Health Survey documented sedentary behavior in 88.6% of the Chilean population [33]), 77% had uncontrolled blood pressure (>140/90mm/hg). This study underscores the conundrum in assessing the benefits of physical activities in the real world practice settings when coexisting morbid entities are frequent confounding factors.

Conclusions

Solid evidence supports today the contributions of regular physical activity for preventive, cardiovascular rehabilitation and/or therapeutic objectives. It is still not well understood the mechanisms by which this beneficial action is exerted, nor which is the best modality and quantity of exercise in some conditions. However, it is generally agreed that walking 30 minutes at a moderate pace most of the days of the week helps in most cases, although higher energy exercise or alternative exercise modalities such as dynamic or isometric resistance may be helpful according to individual preferences or physical limitations. A significant progress in asserting the health benefits of exercise has been achieved so far. However, changes in the global culture and socioeconomic milieu leading to pervasive sedentary behavior and unhealthy diet represent today a challenge that society urgently needs to address.

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