

How Much and What Kind of Exercise is Needed Across the Average Lifespan to Ensure a "Corpore Sanum"?

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KAVANAGH: *How Much and What Kind of Exercise is Needed Across the Average Lifespan to Ensure a "Corpore Sanum"?. Epidemiologic studies provide compelling evidence of the health benefits associated with regular physical activity. There appears to be a linear dose-response, although some doubt exists as to the minimal volume of energy expenditure required to achieve optimal benefit. Both aerobic and resistance type exercise are part of a balanced lifelong program, with the components of an exercise prescription (type of activity, intensity, duration and frequency) tailored to allow for age, baseline fitness and presence of comorbid conditions. (J HK Coll Cardiol 2006;14(Suppl 2):B51-B54)*

Exercise prescription, training benefits

摘要

日常體育活動能給健康帶來益處，流行病學調查提供了充分的證據。雖然有些懷疑認為存在著最小體能付出而獲得益處，二者間還是呈現出線性劑量響應關係。有氧訓練和阻力訓練是均衡終身訓練計劃的一部分，依據年齡、基礎適應度和出現的伴隨疾病來調整運動處方的成分（運動的類型、強度、時間和頻率）。

關鍵詞：運動處方 訓練益處

One's health status is a product of genotype and environment. With regard to the latter, the two most pertinent influences, apart from climate control, are diet and physical activity. Both are highly modifiable and subject to personal choice. From an evolutionary viewpoint, the need for exercise is an essential part of the human condition, and has its origins in the lifestyle of our hunter-gatherer forbears.¹ It is not surprising, therefore, that there is a substantial body of scientific evidence to show that regular physical activity confers dramatic health benefits; conversely, lack of physical activity is associated with an increase in the incidence in cardiovascular disease, diabetes, hypertension, certain types of cancer, and premature death.² Questions still

remain, however, as to (i) the optimal amount of exercise required for health, (ii) whether there is a minimum "dose", and (iii) what part is played by intensity, duration, and frequency.

How Much Exercise

Pioneer work by Paffenbarger and coworkers determined that a weekly expenditure of 2000 Kcal per week was associated with an increase in life expectancy of one to two years.³ With the accumulation of further data from epidemiological studies it became apparent that (a) there is a linear dose-response relation between volume of physical activity and all-cause deaths (b) a minimum energy expenditure in the order of 1000 Kcal per week is required to achieve a 20% to 30% reduction in all-cause deaths (c) high levels of energy expenditure will result in additional benefit and (d) levels as low as 700 Kcal per week can still have some value.⁴ The American College of Sports Medicine recommends a

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daily energy expenditure of 150 to 400 Kcal.⁵ If carried out every day this would attain the minimum goal of 1000 Kcal per week.

It is customary to prescribe exercise in terms of intensity, duration, and frequency rather than volume. This allows for tailoring of the prescription to allow for individual variables such as age, baseline fitness, and the presence of comorbid conditions. High-intensity short-duration exercise is associated with improvement in cardiovascular fitness, but may court orthopedic injury, and on that basis would seem unsuitable for lifelong adherence. Lower-intensity longer-duration programs are those most frequently quoted in large long-term epidemiological studies and have well documented health benefits.⁵ Currently an intensity range of 40% to 85% of the heart rate reserve (HRR)* is recommended by the ACSM, with low-fit and deconditioned individuals advised to start in the lower segment of the range.⁶

Significant improvement in training effect, cardiovascular fitness and weight loss can occur with several short bouts of exercise equivalent to one long bout, i.e. the total volume of exercise is the same in each regimen.⁷⁻⁹ One study concluded that a training program utilizing two daily bouts of 15 minutes was as effective in reducing the incidence of coronary heart disease as one 30-minute bout.¹⁰ However, to date no study has addressed this in terms of mortality.

Health Benefits

The favourable effect of improved physical activity in the primary and secondary prevention of *cardiovascular disease* in men and women, young and old, is well documented.¹¹⁻¹⁴ Hambrecht and coworkers have demonstrated that an energy expenditure of 1600 Kcal per week halts the progression of coronary artery atherosclerosis, whereas 2220 Kcal per week is associated with plaque regression.^{15,16}

The concept that physical activity may prevent *cancer* is not new. Two surveys in the 1920's involving workers in the United States, Australia and the United Kingdom observed that cancer rates declined with increased physical activity on the job.^{17,18} Since then

more than 100 studies have demonstrated that leisure and occupational physical activity is associated with a reduction in specific cancers, including colon and breast cancer. In the Harvard Alumni Health Study, men who expended 1000 Kcal per week or more experienced half the colon cancer compared with their inactive counterparts.¹⁹ In the Nurses Health Study, women spending 5 hours per week in moderate-intensity exercise experienced a 46% reduction in the risk for colon cancer.²⁰

For breast cancer, a Norwegian study revealed that women who spent at least 4 hours exercising to keep fit had 37% lower breast cancer rates than women whose leisure time pursuits were sedentary.²¹ In the Nurses Health Study, individuals who spent 4 to 7 h.wk⁻¹ in moderate or vigorous recreational activities had a 15% lower risk of developing breast cancer compared with women who spent less than 1 h.wk⁻¹ in these activities.²² Those who spent 7 or hours per week had an 18% lower risk. In the Women's Health Study women who expended 1500 Kcal.wk⁻¹ or more in moderately vigorous recreational activities experienced a 20% lower rate of breast cancer than women who expended less than 200 Kcal.wk⁻¹.²³ It would seem that at least 30 to 60 minutes of moderate to vigorous intensity exercise most days of the week is required to decrease the risk of breast cancer.

Type 2 diabetes, and its precursors abdominal obesity and the Metabolic Syndrome, have reached epidemic proportions in the industrialized world. Inasmuch as the cause lies in our sedentary lifestyle, coupled with our energy-dense refined diet, it is no surprise that regular physical activity and exercise training plays a major role in the primary prevention of type 2 diabetes. Moderately intense exercise carried out two to four times a week was associated with a 32% reduction in the incidence of diabetes in a group of 22000 male physicians followed for 5 years.²⁴

In terms of secondary prevention, a prospective cohort study of 2900 adults with diabetes showed that those who walked 2 hours per week had a 39% reduction in the incidence of premature death from any cause, and a 34% reduction in the incidence of death from cardiovascular disease.²⁵ For those who walked 3 to 4 hours per week the reductions were 54% and 53%

respectively.²⁵ A meta-analysis of 14 controlled trials showed that an exercise program of 8 weeks or more resulted in a statistically significant reduction in glycosylated haemoglobin.²⁶

Patients with type 2 diabetes are advised to exercise aerobically 3 to 4 times weekly for 30 to 60 minutes at a moderate intensity.⁶ The aim should be to accumulate 1000 Kcal per week. Resistance training should also be included in the regimen.

Exercise Program

The foundation for a lifelong exercise habit is laid during childhood. During pre-adolescence, the emphasis should be on active play and enjoyable games. The aim is to counteract sedentary behaviour and develop motor skills. Organized community and school-based sports are introduced during early adolescence, with moderate to vigorous structured exercise programs and sports clubs involvement added in late adolescence.

An effective well-balanced exercise program for adults will include aerobic, resistance, and flexibility activities. Walking, jogging, cycling, swimming, and gardening are the most frequently prescribed aerobic activities. Weight-bearing exercise and resistance training are both effective in improving bone mineral density and preventing osteoporosis. Resistance training is increasingly recommended as part of a conditioning program since it is positively associated with functional independence, mobility, glucose homeostasis, bone health, psychosocial well-being, and overall quality of life, and is negatively associated with the risk of falls, illness, and premature death.^{27,28}

Conclusions

Contrary to earlier held beliefs that only vigorous activities conferred major health benefits, recent data strongly supports the merit of moderate-intensity exercise. With regard to the most appropriate type of activity, walking is the most commonly quoted in epidemiological studies. The choice is apt, since (a) the activity is familiar and is easily incorporated into one's

daily activities, (b) it does not require special equipment and (c) duration and intensity can be precisely expressed in terms of distance and time.

Resistance and weight-bearing exercise becomes increasingly important in coping with the muscle atrophy and bone mineral loss which accompanies aging.

$$*HRR = [(HR_{max} - HR_{rest}) \times \% \text{ intensity}] + HR_{rest}$$

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