How much excercise is enough? Are we sending the right message?

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NZ Med J 2002; 115: 111-3

For decades, health professionals have encouraged people to become more active, thereby reducing the likelihood of developing coronary heart disease (CHD), hypertension, diabetes and other conditions linked to sedentary living. Through the 1970s and 80s, consensus recommendations stated that vigorous activity lasting 20 – 60 minutes should be performed 3 – 5 times per week[1] for health benefit. Large cohort studies have repeatedly shown that the health benefit of regular exercise is dose-dependent with regard to total caloric expenditure[2] and intensity,[3] and thus vigorous activities were the focus of recommendations. Unfortunately, such recommendations have not resulted in a greater percentage of the population becoming more active.[4]

In 1995, an expert committee on exercise and health convened by the Center for Disease Control (CDC) and the American College of Sports Medicine reviewed the available data with the goal of establishing a new consensus guideline designed to encourage the ever-growing sedentary population to begin some form of regular exercise. Close examination of data from prospective studies revealed that a caloric expenditure of approximately 1500 kcal/week was the minimum threshold of activity providing a health/survival benefit.[4,5] More importantly, it was determined that daily or near daily performance of moderate intensity activities could achieve this goal. This prompted a major change in the exercise message, which now stated "Every US adult should accumulate 30 minutes or more of moderate intensity physical activity on most, preferably all, days of the week".[4] The scientific merit of this recommendation for the general population has been debated,[6] and opponents argue that there is much stronger evidence supporting a health benefit from vigorous exercise for non-sedentary individuals.

The authors of the CDC recommendation admit that the new guideline focuses on the least fit individuals who are unlikely to become involved in more vigorous levels of activity, and they acknowledge a strong likelihood that vigorous exercise and greater weekly energy expenditures provide greater benefit.[4] From a public health perspective, this approach is justifiable, as the most sedentary have the highest mortality burden.[7] However, for a general practitioner (GP) or practice nurse assisting an individual patient, close adherence to these guidelines may inhibit capable individuals from performing higher intensity activity, which provides greater health benefit.

In New Zealand, GPs appear to be less likely to recommend more vigorous exercise (unpublished findings from the Hillary Commission). Thus, the trend for exercise recommendations appears to be that as westernised society becomes less and less fit, recommendations are simply decreased, as exemplified by the National Health Committee of New Zealand, which recently stated that even 1000 kcal/week will provide a health benefit.[8]

Is less than 1500 kcal/week beneficial?

While there is some evidence to support the National Health Committee's claims, there is very little evidence that refutes them. The 'cut-offs' used for minimum energy expenditure in previous studies have seemingly been randomly assigned and thus may not accurately determine the minimum energy expenditure required for benefit. The MRFIT trial[5] stratified

subjects into tertiles of estimated leisure-time physical activity and found that the middle tertile, who averaged 224 kcal/day (approximately 1500 kcal/week) in leisure-time physical activity, provided the maximum survival benefit (no additional benefit in the highest tertile). The 1978 assessment of the Harvard Alumni data[9] selected 2000 kcal/week as the dividing line for their comparison, and, not surprisingly, found a significantly better outcome for those above 2000 kcal/week. A more thorough assessment of the same data set in 1986 showed that mortality rates decreased steadily from 500 through 3500 kcal/week suggesting that a 'threshold' for health benefit may occur at some energy expenditure lower than 2000 or even 1500 kcal/week.[2] These findings suggest that very low levels of activity will improve the health of sedentary individuals. The fact remains however, that stronger evidence supports an increased benefit at higher caloric expenditures, which may include 'vigorous' activity.

Is vigorous exercise more beneficial?

The majority of literature suggests that the health benefits of exercise for cardiovascular disease (CVD) are dose-dependent. However, only recently has direct evidence supported the claim that vigorous activity is more beneficial than moderate or light activity. Recent reports of the Harvard Alumni Trial indicate that survival benefit increases as self-reported involvement in 'vigorous sport activity' increases. In one report which separated the individual effects of self-reported blocks walked, stairs climbed, sports or recreational activities (moderate and vigorous), only total sports and recreational activity ($p = 0.042$) and vigorous activities ($p = 0.02$) were inversely associated with CVD.[10] Another report of the Harvard data[11] shows that light activity (< 4 metabolic equivalents or METs) provided no benefit ($p = 0.72$), moderate activity (4-6 METs) provided some benefit ($p = 0.07$) and vigorous activity (> 6 METs) predicted clear mortality benefit ($p < 0.001$).

Earlier studies estimated weekly caloric expenditure from leisure time activity,[2,5,9] without carefully accounting for the intensity of activities performed. From these studies it could only be assumed that higher self-reported weekly caloric expenditures are more likely to be achieved with vigorous activity. For example, using CDC calculations, 3000-3500kcal/week, which has been reported as the level of activity providing the greatest benefit[2] would require a 75 kg individual to walk at 6.4 km/hr for 68-80 minutes every day of the week (8.0 - 9.3 hours/week). Alternatively, the same individual could achieve this expenditure by jogging 27-32 minutes per day at 12 km/hr.[12] Indirectly, this suggests that the benefit of 30 minutes of physical activity per day increases with increasing intensity levels.

Exercise prescription in New Zealand

Physician-advised exercise prescription has been shown to involve greater numbers of patients in regular exercise.[13] In New Zealand, the Green Prescription initiative was started by the Hillary Commission in 1997 in an attempt to involve GPs in getting more New Zealanders active. The prescription, which is written by physicians and practice nurses, adheres closely to the CDC recommendations, outlining the frequency and duration of walking or 'moderate activity' the patient should perform. The Hillary Commission has also produced physical activity guidelines for health professionals stating that vigorous exercise adds additional benefit and should be conducted three days a week for 20 minutes or more for extra health and fitness.

Statistics gathered in a randomised clinical trial showed that NZ GPs successfully increased participants' recreational physical activity and felt that written prescriptions helped them formalise exercise goals for participants. They also felt that written prescriptions were more effective than verbal advice alone.[14] In the most recent survey, responding GPs (50%) wrote an average of 3.7 scripts/month, or 57 720 prescriptions annually (unpublished data from the Hillary Commission). These data clearly identify the potential for GPs to influence the behavioural patterns of New Zealanders. However, the answers to two new questions in the survey may demonstrate a misinterpretation of the CDC recommendations. The first asked if the GPs believed that 30 minutes of moderate physical activity most days improves health and the second asked if vigorous exercise for 30 minutes three days of the week helped. Despite evidence that the health benefit of exercise is dose-dependent, 96% of GPs agreed with the moderate exercise message, but only 47% agreed with the benefits of vigorous exercise (unpublished results). Furthermore, misinterpretation of 'moderate' activity by physicians and patients may result in well-intending individuals undertaking an exercise regime which fails to meet the requirements for a health benefit, or certainly fails to maximise any benefit.

What is moderate activity?

The intensity of any activity is relative to the individual. The commonly accepted definition of moderate intensity exercise is 45-59% of an individual's maximum aerobic capacity.[15] In healthy, normally active individuals, age and gender are the major determinants of maximal aerobic capacity (MAC) and the following two regression equations can be used to estimate an individual's MAC in metabolic equivalents or METs:[16]

Males MAC = [60 - (0.55 x age)]/3.5
Females MAC = [48 – (0.37 x age)]/3.5

Using 45-59% of the MAC so determined can be prescribed as a starting 'intensity' of exercise. The weekly 'dose' of exercise is then determined by the duration and frequency of each bout of this intensity ('dose' = intensity x duration x frequency). To calculate this weekly 'dose' of energy expenditure the intensity in METs (Table 1) is converted to the caloric expenditure for the particular individual by multiplying METs x 1 kcal/kg/hour. Thus, the energy expenditure of an activity of 5 METs intensity, (very brisk walking) undertaken by a 75 kg person is:

5 x 1 kcal/kg/hour (1 MET) x 75 kg = 375 kcal/hour.

Table 1. Examples of energy expenditure from leisure activities of intensity between 3-6 METs.

Specific leisure activity	MET value	Energy expenditure (kcal/kg/hour)
Bicycling, < 16 kph	4.0	4.0
Bicycling, 16 – 19 kph	6.0	6.0
Swimming, leisurely, not lap swimming	6.0	6.0
Walking, 4.8 kph (3 mph, moderate pace)	3.3	3.3
Walking, 6.4 kph (4 mph, very brisk pace)	5.0	5.0
Walking, 5.6 kph uphill (3.5 mph)	6.0	6.0

MET data from reference [12].

If this activity has a duration of 30 min (0.5 hour) and is repeated every day of the week the 'dose' of exercise is:

375 kcal/hr x 0.5 hr/day x 7 days = 1312.5 kcal/week

Calculating the absolute amount of energy expenditure (dose) on a daily or weekly basis is useful because health benefits have usually been expressed in relation to absolute energy expenditure. Note that the weekly expenditure calculated in the example above is less than the CDC

minimum threshold of 1500 kcal/ week despite meeting the recommendation of moderate activity for 30 min of most days of the week. Even if a minimum energy expenditure threshold is conclusively established, it should not obscure the fact that increasing expenditure above this level will further increase health benefits.

In an attempt to apply a relative measure to a large population, the CDC recommendation defines moderate activity as 3-6 METs for all individuals regardless of age, gender or fitness level. Figure 1 shows that some part of this range falls within 45 – 59% of predicted MAC for any age/gender stratification. Nonetheless, most of this range would be classified as light activity for males up to age 40 or vigorous activity for people 60 or older. For these reasons, and individual differences in fitness and exercise risk, exercise prescription should be individualised when possible.

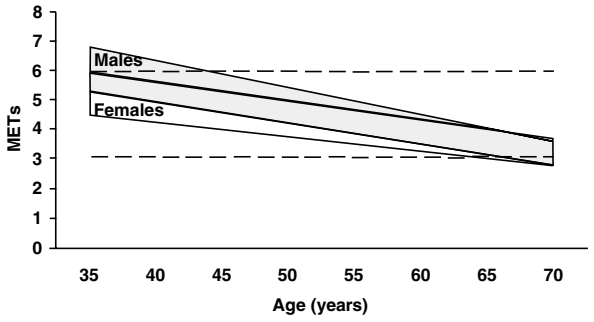

Figure 1. Population versus individual estimates of moderate physical activity. Age and gender-based predictions of moderate activity level (shaded bars) as compared to the CDC recommendatoins of 3 – 6 METS.[4,16]

Is there an acute risk associated with vigorous exercise?

The risk of cardiovascular complication is transiently higher during or immediately after vigorous exercise, particularly in those who do not perform vigorous activity regularly. The relative risk of acute myocardial infarction increases by up to six-fold during vigorous physical activity.[17] The risk of cardiac arrest during exercise has been estimated to be 56 times greater in sedentary men, but only 5 times greater in those with high levels of habitual physical activity.[18] Not surprisingly, habitual vigorous physical activity reduces the rate of sudden death[18] particularly during vigorous activity.[19] However, the rate of cardiac arrest during vigorous physical activity may be up to 100-fold higher in those with coronary artery disease.[20] For these individuals, or those with 'high risk' for coronary artery disease, moderate intensity physical activity may be more appropriate.

A revised message

It is clear that formalised exercise prescription by GPs and practice nurses has the potential to alter the lifestyle, and thus improve the health of New Zealanders. Furthermore, this method of intervention (Green Prescription) seems to effectively involve more individuals in physical activity than other, non-medically prescribed methods. Based on a paucity of well-quantified exercise data, low levels of physical activity (< 1000 kcal/week) may provide some health benefit to those who are older or currently sedentary. However, there is stronger evidence to suggest that greater doses of physical activity, which may include vigorous activity, provide additional benefit for non-sedentary, healthy individuals. For these reasons, GPs and practice nurses should individualise their exercise prescription based on age, gender and fitness level, and encourage vigorous (> 6 METs) activity in those who are younger, healthy and capable of performing it.

A GP's exercise prescription 'ready reckoner', which provides tables and instructions for appropriate exercise prescription, is available from:

Sport and Recreation NZ (formerly the Hillary Commission)
PO Box 2251,
Wellington.

Acknowledgements. We are grateful to Diana O'Neill and the Hillary commission for providing unpublished findings referenced in this manuscript.

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