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COMMENTARY

The Fifth Decade of Exercise and Ageing Research

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Abstract

This commentary reflects on the five decades of Dr. Roy J. Shephard's involvement with studies and review articles on the topic of "exercise and ageing", and integrates this involvement with the exercise and ageing research of Dr. D.H. Paterson. Shephard was a pioneer in the conduct of an exercise training study of older adults in the 1970s, and has continued to publish in this field to the present. In particular, this paper highlights Shephard's corroboration with my own research and writing in emphasizing the importance aerobic exercise for older adults in addressing issues of functional losses and loss of independence, as well as the risk of chronic diseases of ageing.

Introduction

I was a doctoral student in residence at the University of Toronto from 1972-1975. I was "tasked" with work on the "cardiac study" (Ontario Exercise-Heart Collaborative Study) for my research assistant funding and for my thesis direction. A laboratory to measure oxygen uptake and cardiac output (CO₂ rebreath) was established at the Toronto

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Rehabilitation Centre with collaboration of Dr. T. Kavanagh, and Dr. R. J. Shephard was my thesis advisor (and "red-ink" editor, to fix the long sentences in which the "many clauses were randomly distributed"!)). The experience of testing pre- and post-training of more than 100 "cardiac patients" (Paterson et al., 1979), at least in part, set me on a career path regarding the benefits of exercise to health and to "function" (an important outcome for many of the "cardiacs" was the return to a full, active life). Much of my research since has examined exercise responses and physiological limitations in healthy older adults. A longitudinal cohort study of relationships of physical activity levels and fitness of older adults with health and "well-being" in older age established the importance of aerobic fitness in the maintenance of independence into old age (Paterson et al., 2004). Recent exercise training studies of older adults have explored the time-course and mechanisms of adaptation in both older men and women (Murias et al., 2010a; Murias et al., 2010b).

Our group at the University of Western Ontario decided in the mid-1980s to pursue studies in exercise and ageing, and established the Centre for Activity and Ageing as a "Research Centre" of the University; while we were almost pioneers in this effort, indeed Dr. Shephard was a decade or more ahead of

us. While I was at U of T, Ken Sidney was conducting exercise training classes with older adults. A series of papers followed in 1977-8 with a review, "Exercise and Aging", in *Exercise and Sport Science Reviews* (Shephard and Sidney, 1978). Research contributions from Shephard and colleagues on topics of exercise and ageing continued sporadically throughout the 1980s and the *Journal of the American Geriatric Society* published a review in 1990 "The Scientific Basis of Exercise Prescribing for the Very Old". In the 1990s the theme of immune function featured a number of articles regarding immune function with ageing. And Roy is back at it again with a number of articles from the "Nakanojo Study" with Y. Aoyagi (Aoyagi and Shephard, 2010).

Thirty-five years ago there was the notion that with age we may lose the "ability" to adapt to a stress, and thus exercise training of older adults might have little or no effect, or that older adults would certainly take longer to adapt and exercise interventions were thus "gentle" and progressed very slowly. The potential "catastrophic" cardiovascular risks of exercise suggested contraindication of "vigorous exercise" and strength-related activities were considered too dangerous for older adults. Nevertheless at that time Sidney and Shephard (1978) analyzed the importance of intensity of exercise in their older adult program. And today, recent reviews (Paterson et al., 2007, Paterson and Warburton, 2010) have formed the basis for the recent Physical Activity Guidelines for Older Adults, which recommend aerobic exercise of moderate and vigorous intensity, and the supplemental benefit of including resistance exercises.

With his international recognition Shephard has been able to champion the

messages of the relationships of regular exercise and aerobic fitness of older adults with health and "well-being" in older age, and the importance of aerobic fitness in the maintenance of independence into old age. Thankfully, a review in the *British Journal of Sports Medicine* (Shephard, 2009) corroborates the position taken our 2004 study (Paterson et al., 2004) and in our reviews of the literature that the progressive deterioration of aerobic fitness with age can be a cause of the loss of independence of older adults and thus a regular exercise (physical activity) program, preventing the loss of aerobic fitness, can address issues of functional losses as well as the risk of chronic diseases of ageing. Based on our data Shephard has reinforced the importance of exercise with his calculation that an aerobic training program in older adults could increase their fitness to an extent that would postpone loss of independence by 12-years.

And, thus, in thirty-five years there has been a remarkable growth in our understanding of older adult abilities and the influence of physical activity on health and well-being in older age. Functional independence is a powerful rationale to motivate older adults to take up an exercise program. Presently with the increase in life expectancy many are outliving their "fitness" and succumbing to disabilities of old age. Recommendations of the requisite physical activity types, intensity and volume dose-response required to achieve health benefits and maintain functional independence in the older adults have been derived as the scientific basis of the Physical Activity Guidelines for Older Adults (Paterson et al., 2007; Paterson and Warburton, 2010).

The literature reviewed in Paterson and Warburton (2010) identified that greater physical activity of an aerobic nature was associated with higher functional status in older age. For functional independence (i.e., measures such as ability in activities of daily living), moderate (and high) levels of physical activity appeared effective in conferring a reduced risk of functional limitations or disability, by about 50%. Low levels of physical activity did not confer any benefits. Likewise, the risk for limitations in higher level performance outcomes (i.e., measures such as stair climbing or walking a distance) was also reduced by about 50% with physical activity described as “exercise” or “vigorous”, with an apparent dose-response from moderate through to high activity. Exercise training interventions (including aerobic and aerobic combined with resistance) showed improvement in physiological and functional measures, and suggestion of longer-term reduction in incidence of impaired mobility. A relatively high level of physical activity was related to better cognitive function and reduced risk of developing dementia; however, there were mixed results of the effects of exercise interventions on cognitive function indices, but with growing evidence of a positive effect. This review shows that appreciable benefits are achieved from certain types of physical activity (mainly aerobic/endurance activities each of 10 min or more in duration). There is an effective threshold “dose” of the intensity of exercise being at least into the moderate domain, and perhaps better if vigorous, and a volume of 150 min/week (and approximately 1000 kcal/week; 4200 kJ/week), but somewhat less (e.g., 90 min) with more vigorous activities.

Thus, from a public health perspective, physical activity above baseline “normal” daily activity levels, or a structured exercise program at an intensity of moderate to vigorous with a total weekly volume of 150 minutes will increase cardiorespiratory fitness and translate to a >30% decrease in the relative risk of morbidity and mortality, and loss of independence. Further benefit and greater fitness gain would accrue with greater physical activity. Light activities may be important to avoid “sedentary” health effects, but being active in daily life (going to the mall, belonging to clubs, and play with the grandchildren) and accumulating short-duration, small muscle group and non-aerobic activities will not engender the fitness needed to maintain function and independence. In general, the more time spent being active and the more intense the activity, the better.

Qualifications

The author’s qualifications are as follows: Dr. Donald Paterson PhD.

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