RUNNING PERFORMANCE AND PHYSIOLOGICAL CHARACTERISTICS OF ONE MAN OVER A TWENTY-YEAR PERIOD

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INTRODUCTION

In general there is a slow decline in physical performance during maturity which becomes more rapid with increasing age. Maximum oxygen uptake ($\dot{V}O_2$ max) is regarded as one of the best measurements of physical working capacity; and cross-sectional studies suggest that men lose about 11-14 ml.kg⁻¹min⁻¹ of aerobic power between the ages of 25 and 55 years (Åstrand and Rodahl, 1977; Quirion et al, 1987; Shephard, 1978). Longitudinal studies report quite large decrements of between 10-30 ml.kg⁻¹min⁻¹ over a 20-year period between ages 30 and 50 years (Åstrand et al, 1973; Dehn and Bruce, 1972; Robinson et al, 1975), depending on whether the subjects were inactive, or were active sportsmen. Many researchers suggest that this loss in physiological performance is more related to decreased habitual activity than to age itself. Thus, although it is accepted that the functional capacity of the cardiorespiratory system does decrease with age, this decrease can be minimised by regular physical activity (Barnard et al, 1979). De Vries (1980) further comments that the relative capacity for improvement in performance is probably not greatly different in middle age from that in youth. Thus the purpose of the present study was to examine the effect of training on performance of a subject between the ages of 30 and 50 years.

METHOD

A male subject, initially aged 30 years, ran a series of twelve training runs, during eight weeks between the middle of October and December every year for twenty years. The training run involved running a distance of approximately three miles over roads, a gravel path, up steps and a steep slope. The run was a maximal effort on each occasion.

Each run was timed to the nearest second and, in addition, every four years the subject was measured anthropometrically and physiologically. Height and weight were measured using a Stadiometer and Avery 120 kg scales, and the Heath-Carter method was used to assess the subject's somatotype (Heath and Carter, 1967). A progressive cycle ergometer test to exhaustion was used to determine maximum heart rate and $\dot{V}O_2$ max. Cardiac frequency was monitored throughout each ergometer test, using bipolar chest electrodes in conjunction with an ECG amplifier and pen recorder (Devises).

On the first three test occasions expired air analysis was performed using Standard Douglas bag techniques. On the last three test occasions the expired air was passed directly through a Parkinson-Cowan dry gas meter, and oxygen analysis was made using a Servomex oxygen analyser, calibrated prior to and following each test, using gases of known concentration. Oxygen uptake values were expressed at STPD. As carbon dioxide was not analysed, oxygen uptake was calculated on the assumption that

inspiratory and expiratory volumes were equal. Consequently a small and unknown variation in the calculation of the $\dot{V}O_2$ values may have occurred. Given the above constraints, the measurements taken every four years over the 20-year training period were standardised as closely as possible.

During the first ten years, in addition to the training runs in October and December, the subject played club rugby and continued to run twice a week during the rugby season. After he stopped playing rugby at 40 years of age his main exercise, other than the training runs, was to walk to work, a distance of approximately 15-20 miles (25-35 km) per week.

RESULTS AND DISCUSSION

The anthropometric and physiological measures made every four years are represented in Table I. In order to discuss performance in relation to these anthropometric and physiological parameters, the mean scores of the training runs over a four-year period were calculated and are presented graphically (Fig. 1).

Fig. 1: Mean scores of the Training Runs over each four year period between 1967 and 1986.

The subject's weight increased by only 2.3% over the 20-year period, which is much less than the average weight increase of about 8% for males between 30 and 50 years. There was also a very slight decrease in height. The mesomorphy rating remained the same but there was an increase in endomorphy of one and a corresponding decrease in ectomorphy of half a rating. With the slight increase in weight, these changes suggest that there may have been a small increase in the fat content of the body. However, as somatotype is a morphological frame of reference, and body composition was not measured, this conclusion is only tentative.

There was a decrease in $\dot{V}O_2$ max from 3.62 to 3.2 litres per minute, and $\dot{V}O_2$ max in relation to weight from 54.0 to 46.4 ml.kg⁻¹min⁻¹, representing a decrease of 11.8% and 13.7% respectively. Over the 20 years, therefore, there was a decrease of 7.4 ml.kg⁻¹min⁻¹ or 0.37 ml.kg⁻¹min⁻¹ per year. These findings are similar to those of Dehn and Bruce (1972) in their longitudinal study of active males, to the active runners in Costill and Winrow's study (1970) and the masters runners in Barnard, Grimditch and Wilmore's study

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TABLE I
Anthropometric and physiological variables

Date	Age yr	Weight kg	Height cm	Somatotype			Max heart rate beat.min ⁻¹	Maximum oxygen uptake	
				Endo	Meso	Ecto		l.min ⁻¹	ml.kg ⁻¹ min ⁻¹
1967	30	67.0	181.2	2.0	2.9	5.0	196	3.62	54.0
1970	34	67.8	181.2	2.5	3.0	5.0	192	3.50	51.7
1974	38	68.0	181.0	2.5	3.0	4.8	190	3.29	48.4
1978	42	68.0	180.9	2.5	3.0	4.8	186	3.28	48.3
1982	46	68.4	180.3	2.8	3.0	4.5	179	3.24	47.3
1986	50	68.6	180.0	3.0	3.0	4.5	174	3.20	46.6

(1979). However, the reduction in maximum oxygen uptake was less than that suggested for sedentary males of approximately 0.5 ml. and 0.6 ml.kg⁻¹min⁻¹ per year indicated by Quirion et al (1987) and Shephard (1978) respectively.

Hagberg and co-workers in their study of young and older endurance runners, found that maximum oxygen pulse, maximum stroke volume and maximum arterio-venous difference for oxygen in both groups of runners were similar (Hagberg et al, 1985). They therefore suggest that the major haemodynamic difference between middle-aged and young athletes during maximal exercise is the lower maximal heart rate of the older runners. The lower maximal heart rate with increased age of the subject in this study (Table I) supports these findings. Though the absolute performance of the subject deteriorated during the 20-year period by about 8-10%, the response to training was similar throughout. Over the twelve training runs each year there is improvement of about 12% in run times.

As only one subject was studied, only very tentative conclusions can be made. However, the findings do support the view that a loss of functional capacity with age may be minimised by regular physical activity, and the relative

improvement over a series of training runs is similar from 30 to 50 years of age.

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