Children are fit but not active!

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A recent study of 300 children in the primary and secondary age range revealed disturbingly low levels of habitual physical activity. Without a major effort by parents, teachers, and the community to make sessions of vigorous physical activity more attractive, these youngsters will become increasingly vulnerable to coronary heart disease as they grow older. The need is urgent, and schools can supply a major impetus.

'Physical activity' and 'exercise' are terms which are often used interchangeably, but this can be confusing as they are not synonymous with one another. Physical activity encompasses all skeletal movement, and although levels of physical activity vary considerably from person to person and over time all members of the population exhibit some physical activity. Exercise is a subcategory of physical activity that is planned, structured, repetitive and purposeful. Exercise programmes normally have the objective of either improving or maintaining one or more of the components of physical fitness. Physical fitness may be conceived as 11 separate components grouped into two broad categories. In this taxonomy *agility, balance, co-ordination, power, reaction time* and *speed* are the skill-related aspects of physical fitness. *Cardiorespiratory fitness, muscular strength, muscular endurance, flexibility* and *body composition* are the health-related aspects.

Exercise and cardiorespiratory fitness

I have analysed all the health-related components of physical fitness in depth elsewhere (Armstrong, 1987), but the focus of this paper is on cardiorespiratory fitness, which may be defined as 'the ability of the circulatory and respiratory systems to supply fuel and to eliminate waste products during physical activity'. It has been widely recognised for many years that the maximal rate at which oxygen can be consumed during exercise with large muscle groups (maximal oxygen uptake or $\dot{V}O_2$ max) is the best single indicator of cardiorespiratory fitness (Astrand & Rodahl, 1986). The effects of exercise manifest themselves as adaptive responses by the body to the stress placed on various tissues and biological functions by the increased demands of exercise. If the appropriate type of exercise (see Armstrong, 1987) is performed at the proper intensity, duration and frequency improvement in cardiorespiratory fitness ($\dot{V}O_2$ max) will occur. These adaptations will gradually decay unless the exercise programme is maintained.

The relationship between habitual (regular) physical activity and cardiorespiratory fitness is complex. Cardiorespiratory fitness ($\dot{V}O_2$ max) is a physiological variable whereas physical activity is a behaviour. It has been suggested that high levels of cardiorespiratory fitness may encourage individuals to engage in strenuous occupational and leisure-time activities, but this remains to be demonstrated. It would seem logical that the children with the highest levels of physical activity would have the highest $\dot{V}O_2$ max but, perhaps because of the large genetic component of $\dot{V}O_2$ max, this has not been established.

Measuring fitness and activity

As part of the Coronary Prevention in Children Project (Armstrong *et al.*, 1987) we have tried to clarify the relationship between children's cardiorespiratory fitness and habitual physical activity. We determined the $\dot{V}O_2$ max (or Peak $\dot{V}O_2$, see Armstrong & Davies, 1984 for an explanation) of over 200 children, aged 11 to 15 years, by running them to exhaustion on a treadmill and simultaneously monitoring their cardiorespiratory responses to the exercise. Our results have demonstrated that the children are as 'fit' as the first children ever to have their cardiorespiratory fitness scientifically assessed in a laboratory over 50 years ago. More detailed comparisons with results from elsewhere have shown that British children are as 'fit' as children from similar environments, and that there is no scientific evidence to support the premise that the cardiorespiratory fitness of children has deteriorated over time.

To estimate children's habitual physical activity we utilised a self-contained, computerised telemetry system (Sport Tester 3000) to record continuously their minute-by-minute heart rate. The Sport Tester 3000 consists of a light-weight transmitter, which is fixed to the chest with electrodes, and a receiver and microcomputer which is worn as a watch on the wrist. The Sport Tester is capable of storing minute heart rates for up to 16 hours, and if it is interfaced with a microcumputer the development of a simple programme allows sustained periods with heart rates above appropriate thresholds to be readily identified and recorded. Using this methodology we have monitored the daily heart rates of over 300 children for a minimum period of three weekdays and a Saturday. *No relationship was found between habitual physical activity and cardiorespiratory fitness ($\dot{V}O_2$ max).*

Physical activity must be 'vigorous'

Regular, vigorous physical activity using large muscle groups for sustained periods of time is the only type of activity that is consistently and substantially associated with a lower incidence of coronary heart disease (CHD) (Morris *et al.*, 1987). Morris, however, defines vigorous activity as 'liable on average to entail peaks of energy expenditure of 7.5 kilocalories per minute'. An intensity of 7.5 kcal per minute is of a lower intensity than that normally prescribed in an aerobic exercise programme, and approximates to only about 70% of maximal heart rate in adults. A recent review of physical activity recommendations for children (Simons-Morton *et al.*, 1988) concluded that

Fig. 1. A 12-year-old boy wearing the Sport Tester 3000 heart rate transmitter and receiver.

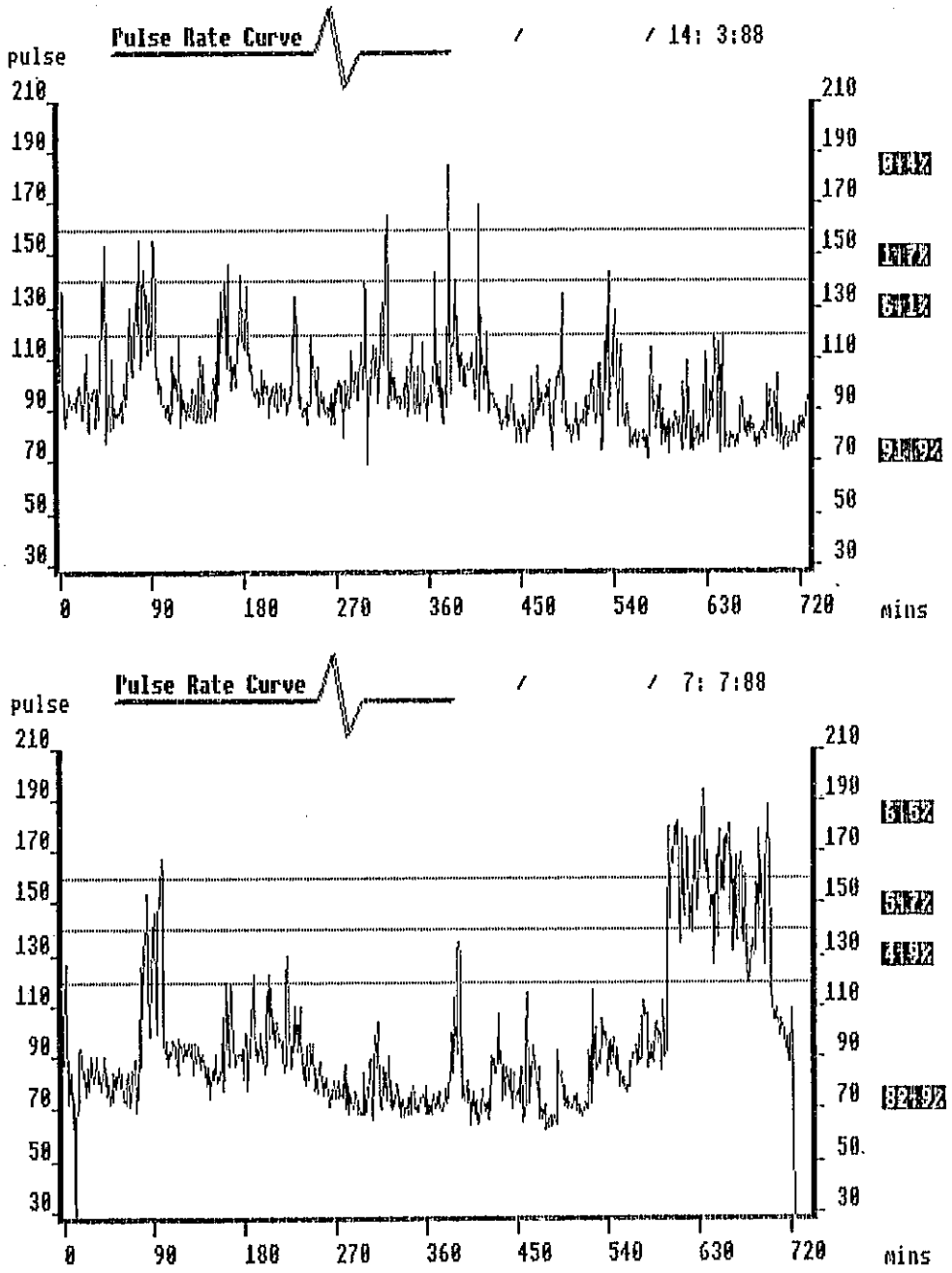

Fig. 2. Two 12-hour tracings obtained with the Sport Tester 3000, showing the percentage of time during which different heart rate levels were achieved. The upper trace shows no 'appropriate' activity, but the lower trace reveals that during 12.2% of the time the heart rate was at or above 140 beats per minute.

appropriate physical activity involves large muscle groups in dynamic movement for periods of 20 minutes or longer, three or more times per week, at an intensity eliciting heart rates equal to or in excess of 140 beats. min^{-1} (approximately 70% of maximum heart rate). This is in close agreement with Morris' recommendations for adults.

To put this level of activity into perspective, the children we monitored elicited heart rates in excess of 140 beats per minute when walking briskly or jogging slowly (6–8 km per hour) on a treadmill.

Fewer than 15% of the girls and 30% of the boys we studied achieved a single 20-minute session with their heart rate above 139 beats per minute during three days of monitoring. 50% of the girls and over 25% of the boys did not even manage a single 10-minute period with their heart rate above 139 beats per minute. The boys were, however, significantly more active than the girls. We also studied a group of primary school children (age 10 years) and discovered that there was no significant difference between the activity levels of the girls and the boys. There was no difference between the activity levels of the primary and secondary schoolboys, but the primary schoolgirls were significantly more active than the secondary schoolgirls. Monitoring the heart rates of the same children on Saturdays demonstrated that all groups were even less active at the weekend than during the week.

Our data, the first to be generated from British children, indicate that children have surprisingly low levels of physical activity and that many children seldom experience the intensity and duration of physical activity associated with a lower incidence of CHD in adults. Teenage girls appear to be a particular problem.

Encouraging a more active lifestyle

Public awareness of the importance of increasing children's physical activity patterns needs to be raised and we have found local radio stations to be very willing to co-operate in doing this. Attractive and accessible sports facilities need to be made available, for reasonable cost, at times when children can use them. Yet, at a time when local authorities and local education authorities should be extending multi-use of their facilities, evidence is accumulating to support the view that the problem of maintenance of facilities and resources for physical education is becoming a serious one (Physical Education Association, 1987).

Lack of opportunity to participate has not been identified as a major factor in the Coronary Prevention in Children Project, but many of the children we have studied have emphasised the value of a family approach to encouraging activity. They have particularly highlighted the importance of parental and sibling example. Attitudes towards physical activity are established at an early age, and parents therefore have a prime responsibility to provide a positive role model and to encourage their children to engage in active play, both spontaneous and formal; but the community must provide adequate safe, clean play areas for this to take place.

The part schools can play

The primary school offers an ideal environment in which active lifestyles in partnership with the home can be further fostered. Children's natural curiosity can be used to help them to understand how their bodies function and the importance of physical activity can be emphasised and related to other aspects of education. The introduction of the National Curriculum invites primary schoolteachers to explore possibilities for developing aspects of the core subjects in the context of the other foundation subjects. This opportunity, in the present context, has been clearly recognised and illustrated in *Science in the National Curriculum* (National Curriculum Council, 1989).

In the secondary school it would be wrong to divorce physical activity from other aspects of a healthy lifestyle, and special provision needs to be made for a cross-curricular approach to activity education. The emergence of the National

Curriculum has provided a useful vehicle for work of this nature. Physical education staff must grasp the opportunity to contribute to the many relevant areas included in *Science in the National Curriculum.* Relevant parts of the programmes of study should be interpreted with the emphasis on the promotion of active lifestyles which will persist into adult life.

Achieving 'activity independence'

Within traditional physical education it must be clearly demonstrated to children that physical activity can be enjoyable and that athletic excellence is not necessary for the promotion of health. Children need to be exposed to a wide variety of individual, partner and team activities, and the emphasis should be placed upon developing a sound foundation of motor skills which can contribute to successful and enjoyable activity experiences both in the present and in the future.

Although the provision of a high activity content should be an important component of most physical education lessons, the principal objective underpinning the inclusion of health-related activity in the physical education curriculum should be for children to achieve 'activity independence'. Teachers must help and encourage children to internalise the motivation to be active so that when the extrinsic motivation of the teacher is removed they will continue with an active lifestyle. To achieve 'activity independence', children should be helped to understand the principles underlying healthy activity and taught how to become informed decision makers who can plan and implement individual activity programmes which can be periodically reappraised and modified as they get older.

Children's cardiorespiratory fitness does not appear to be a major problem, but the current level and pattern of children's physical activity is a cause for grave concern. Teachers at all levels of education must collaborate, in partnership with the community and the home, to meet this challenge. The future health of our children depends upon it.

Acknowledgement

The data referred to in this paper were collected in collaboration with my friends and colleagues John Balding, Peter Gentle, Jo Williams and Brian Kirby. The work was supported by the Northcott Devon Medical Foundation, the Oxenham Will Trust and the IBM (UK) Trust.

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