

relationship between 11 to 16 year old students' directly determined VO_2 and their physical activity patterns. Peak VO_2 and habitual physical activity was determined in 111 girls and 85 boys. Volume of habitual physical activity (frequency, intensity, and duration) was estimated from minute-by-minute heart rate monitoring over three 12 hour periods during normal school days. As in Armstrong's previous study, the device used to measure heart rate was the Sport Tester 3000.

Results revealed that the 'vast majority of children and adolescents rarely experience sustained periods of physical activity of sufficient intensity and duration to overload the cardiopulmonary system.' Over half of the girls and a third of the boys failed to sustain a single 10 minute period with their heart rate at or above 140 bpm. Only one boy sustained a daily 20 minute period with a heart rate at or above 160 bpm.

Armstrong et al., (1990b) conducted another study on a larger sample of children. The objective of the study was to examine the patterns of physical activity among British school children and to assess whether the children experienced the intensity and duration of physical activity believed to stress the cardiopulmonary system appropriately. Two hundred and sixty six children (aged 11-16), from two communities in Devon, were randomly selected to participate in the study. Physical activity was estimated from continuous monitoring of heart rate over three weekdays and a Saturday.

It was again found that British children had surprisingly low levels of habitual physical activity and many seldom undertook the volume of physical activity believed to benefit the cardiopulmonary system. The boys were more active than the girls, displaying heart rates greater than 139 bpm for a significantly higher percentage of time during the weekday (6.2% in boys versus 4.3% in girls), and on the Saturday (5.6% versus 2.6%).

Armstrong et al., (1990c) conducted a further study which provides information on children's activity levels. This research was primarily concerned with the prevalence of coronary risk factor variables in

British children. Physical activity therefore represented just one aspect of the study. Heart rate data were obtained over 12 hours on 32 boys and 44 girls from two large community colleges. Results revealed that the girls maintained their heart rates above 159 bpm for 1.5% of the time (SD = 1.7) while the boys managed 2.6% of the time at this intensity (SD = 3.2).

The physical activity patterns of British primary school children were studied in a survey conducted by the Happy Heart Project (Sleep & Warburton, 1990). This survey was carried out on primary school children aged five to eleven years from different regions of England. The bulk of the data was obtained using a general evaluation which involved parents filling in a detailed activity diary including all the activity their child(ren) did outside of school. In addition, an intense minute by minute observation was carried out on a small sample of the children using a method based on an American observation procedure. The observation involved studying the children's activity during breaking times, lunchtimes, P.E. lessons and outside of school hours.

The major finding of this survey was that primary aged children did very little vigorous physical activity. The qualification of vigorous activity was any activity that made a child sweaty and/or out of breath. During the period of the investigation, half of the children took part in no vigorous activity, and the longest period of continuous vigorous physical activity recorded was only eight minutes.

Armstrong & Bray, (1991) investigated the physical activity patterns of 132 British primary school children. The heart rates of 67 boys and 65 girls (mean age 10.7 years) were monitored continuously for three 12 hour periods during normal school days. Thirty nine children also had their heart rates monitored during a 12 hour period on a Saturday.

The results revealed that few children experienced the volume of physical activity associated with an improvement in cardiopulmonary fitness. However, when the number of children who had sustained five minute and 10 minute periods with heart rates above 139 bpm and 159 bpm were analysed, it was found that shorter (five

minute) periods of 'appropriate' activity were quite common. No difference was found between the boys and girls in terms of moderate amounts of activity, but the boys displayed more five minute periods of intense activity than the girls.

On the basis of the findings from the study, it was declared that sustained periods of activity are not features of children's physical activity. Rather, the claim was made that 'the physical activity patterns of primary school children consist of relatively short periods of physical activity.' It was suggested that this may be as a result of their limited attention span.

A more recent study by Armstrong et al., (1991) investigated the cardiopulmonary fitness, physical activity patterns and selected coronary risk factor variables in 11- to 16-year old children. The heart rates of 199 boys and 164 girls were monitored during three weekends. In analysing the physical activity data, low levels of activity were again evident. Results showed that 35.9% of the boys and 47.8% of the girls did not manage a single ten minute period of activity with their heart rates above 139 bpm. The girls maintained their heart rates above 159 bpm for only 1.26% of the time (SD = 1.59). The boys maintained their heart rates at this level for 2.67% of the time (SD = 2.05).

Conclusion

As can be seen from the above review, the information available on the activity levels of British children is limited. On the basis of the findings from the majority of the studies, it is apparent that British children are not very active. The studies outlined are in agreement that, generally, activity levels in young children are low, with many children not taking sufficient exercise to enhance their health status. It is repeatedly reported that levels are insufficient to develop the cardiovascular system and promote cardiovascular health (Williams, 1988; Armstrong, 1989; Armstrong et al., (1990a); Armstrong & Bray, (1991). The low levels of activity are furthermore most marked in females and in older children. A number of studies report males to be more active than females (Durnin, 1967; The

Sports Council for Wales, 1987; Williams, 1988; The Northern Ireland Fitness Survey, 1989; Armstrong 1989; 1990a; 1990b), and/or report that activity levels decrease with age (Dickenson, 1987; The Sports Council for Wales, 1987; The Northern Ireland Fitness Survey, 1989). A summary of the findings of each study outlined in this review is presented in Figure 1. Despite some studies reporting children to be active (McKusker, 1985; The Sports Council for Wales, 1986), such findings are very much in the minority, and as was highlighted earlier, important information is lacking in these studies with respect to the frequency, intensity, duration and type of activities the children reported to engage in.

Given the relationship between physical activity and CHD risk factors outlined earlier, the implications of the findings presented here are worrying and highlight a serious cause for concern. These associations are, furthermore, of particular significance because such risk factors are known to track over time (Freedman et al., 1985; Lauer, Lee & Clarke, 1989). Clearly though, the research evidence is limited and far from comprehensive. Of the studies which have reported the extent and nature of children's physical activity, the sample size in some instances are notably small and they are often difficult to interpret and compare due to differences in methods used. Such problems really do highlight the need to carry out detailed investigations of the physical activity levels of children in this country. It is essential that the importance of physical activity to the health of our young population is recognised and that large scale and detailed studies along the lines of those conducted in the United States, Canada and Australia are initiated in this country. Only then will any firm conclusions be able to be drawn as to how active or inactive our young people really are.