Patterns of physical activity among 11 to 16 year old British children

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Abstract

Objective — To examine the patterns of physical activity among British schoolchildren aged 11 to 16 and to assess whether the children experience the intensity and duration of physical activity that are believed to stress the cardiopulmonary system appropriately.

Design — Cross sectional study of a sample of children drawn from a large survey of coronary risk factors in children. Continuous monitoring of heart rate for 12 hour periods on three school days and one Saturday.

Setting — Two communities in Devon.

Sample — 266 Children (163 girls, 103 boys) aged 11 to 16 randomly selected from a sample of 707 children.

Main outcome measures — Percentage of time and number of sustained periods in which heart rate was >139 beats/min. Anthropometric measures and external assessment of sexual maturity with Tanner’s indices.

Results — The boys had heart rates >139 beats/min for a significantly higher percentage of time than the girls (p<0.01) during the weekday (6.2% v 4.3%) and the Saturday (5.6% v 2.6%). The boys had significantly more five and 10 minute periods with heart rates >139 beats/min than the girls during the Saturday and weekdays and more 20 minute periods during the weekdays. 84 Girls and 37 boys had no 10 minute period with a heart rate >139 beats/min during the three weekdays and 112 girls and 65 boys had no such 10 minute period during the Saturday. No significant relation was detected in either sex between the amount or habitual physical activity (heart rate) and skinfold thickness or maturity group.

Conclusions — British children have surprisingly low levels of habitual physical activity, and many children seldom undertake the volume of physical activity believed to benefit the cardiopulmonary system. Boys are more active than girls. The pubertal stage of development or body fatness, or both, do not seem to be sensitive indicators of physical activity in either girls or boys.

Introduction

Simons-Morton et al recently reviewed published recommendations for physical activity for children and concluded that appropriate physical activity entailed dynamic movement of large muscle groups for 20 minutes or longer, three or more times a week, at an intensity eliciting heart rates ≥140 beats/min (roughly 70% of the maximal heart rate). Whether British children regularly undertake this degree of physical activity was unknown. We therefore examined the patterns of physical activity among British schoolchildren aged 11 to 16 and assessed the amount of appropriate physical activity.

Subjects and methods

We invited all children in state school years seven to 10 in two well defined communities in Devon to participate in a research project on the prevalence of coronary risk factors in children. The two localities surveyed were broadly comparable with much of
southern England. Written informed consent was obtained from 707 children (42% of those eligible) and their parents. In an attempt to detect sample bias we compared the heights and weights of the children who participated in the study with those of the children who declined to participate. Analysis by t test showed no significant difference (p>0.05) in either height or weight in any year group for either sex. We randomly selected 266 of the children to have their patterns of physical activity monitored and collected data throughout one school year (September to July).

**PHYSICAL CHARACTERISTICS**

Height, weight, and skinfold thickness over the triceps and the subscapular region were measured according to the techniques described by Weinier and Lourie. All skinfold measurements were carried out by the same experienced observer, and the sum of skinfold thicknesses was obtained by adding the scores for the triceps and the subscapular region. The external sexual maturity of 219 children was assessed visually using the indices developed by Tanner.

**ASSESSMENT OF PHYSICAL ACTIVITY**

The volume (frequency, intensity, and duration) of physical activity was estimated from continuous monitoring of the heart rate over three weekdays and one Saturday. This is not a direct measure of physical activity, but, perhaps more importantly, it measures the relative stress placed on the cardiopulmonary system. In other words, it reflects the heart rate in the same way as the blood pressure reflects blood pressure. For an exercise to be of value, however, we assumed that the response of the heart rate indicates the volume of physical activity.

We used a self contained, computerised telemetry system (Sport Tester 3000, Cranlea Ltd, Birmingham) to record minute by minute heart rates continuously. The system can store and replay minute by minute heart rates for up to 16 hours, and if it is interfaced with a microcomputer sustained periods with heart rates above 70% of the maximum can be readily identified and recorded. Each child was monitored from about 0900 until 2100 during a normal school day. The receivers were retrieved, replaced, and refitted the next morning, and the process was repeated over three days. Data for three school days were obtained on 163 girls and 103 boys. In addition, 92 of the boys and 120 of the girls were monitored from 0900 until 2100 on a Saturday.

**STATISTICAL ANALYSIS**

The data were stored and analysed with an RSI database (BBN Software Products, Chicago). Means and standard deviations were computed, and significant differences were tested by the appropriate t test or, for multiple groups, by one way analysis of variance and Scheffe analysis. Pearson product moment correlation coefficients were calculated when appropriate.

**Results**

Table I shows the physical characteristics of the children. The boys had heart rates >139 beats/min for a significantly higher percentage of time than the girls during the weekdays (6.2% vs 4.3%) and the Saturday (5.6% vs 2.6%). The relation between age and the percentage of time with a heart rate >139 beats/min was not significant for boys, but a negative correlation with age was found for girls (weekday: r = -0.27, p<0.01; Saturday r = -0.29, p<0.05).

The interpretation of data on continuous heart rate is complex because the data reflect not only the metabolism of the child but also the transient emotional state, the prevailing climatic conditions, and the specific muscle groups being exercised. Although the percentage of time spent with various heart rates is of interest, the primary consideration of this study was the number and length of sustained periods with a heart rate >139 beats/min (appropriate physical activity). Table II shows the percentage of children who had five, 10, and 20 minute periods with heart rates >139 beats/min. The mean numbers of five, 10, and 20 minute periods were significantly higher among boys than girls (p<0.01) during the weekdays, as were the mean numbers of five and 10 minute periods during the Saturday (p<0.01). Brisk walking on a treadmill at 6 km/h gave steady state heart rates averaging 146 beats/min in these children.

Table III gives the characteristics of the children according to maturity groups. Analysis showed that the mean percentage of time with a heart rate >139 beats/min for girls in group 2 was significantly higher (p<0.05) than that for girls in groups 4 and 5. No significant differences in sustained periods of appropriate physical activity were detected among maturity groups in either sex.

**Discussion**

No other published study has used unobtrusive monitoring of the heart rate of British children for extended periods. Our results therefore provide the first objective support for the limited self reported data currently available on British children. Our data are

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**TABLE I—Physical characteristics of children monitored for three weekdays. Values are means (SDs)**

<table>
<thead>
<tr>
<th>Boys (n=103)</th>
<th>Girls (n=163)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>13-1 (1-2)</td>
</tr>
<tr>
<td><strong>Height (m)</strong></td>
<td>1.57 (0.11)</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>47.5 (11.2)</td>
</tr>
<tr>
<td><strong>Sum of skinfold thicknesses (mm)</strong></td>
<td>19.7 (8.9)</td>
</tr>
</tbody>
</table>

**TABLE II—Number of sustained periods with heart rate >139 beats/ min recorded during continuous monitoring of children aged 11 to 16. Values are numbers (percentages) of children**

<table>
<thead>
<tr>
<th>Period</th>
<th>Boys (n=103)</th>
<th>Girls (n=163)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5 Min</strong>:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>5 (4.9)</td>
<td>23 (14.1)</td>
</tr>
<tr>
<td>1</td>
<td>14 (13.6)</td>
<td>26 (16.0)</td>
</tr>
<tr>
<td>2</td>
<td>12 (11.7)</td>
<td>27 (16.6)</td>
</tr>
<tr>
<td>≥3</td>
<td>72 (69.9)</td>
<td>87 (53.4)</td>
</tr>
<tr>
<td><strong>10 Min</strong>:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>37 (35.9)</td>
<td>84 (51.1)</td>
</tr>
<tr>
<td>1</td>
<td>27 (26.2)</td>
<td>34 (20.9)</td>
</tr>
<tr>
<td>2</td>
<td>15 (14.6)</td>
<td>25 (15.3)</td>
</tr>
<tr>
<td>≥3</td>
<td>24 (23.3)</td>
<td>20 (12.3)</td>
</tr>
<tr>
<td><strong>20 Min</strong>:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>79 (76.7)</td>
<td>141 (87.7)</td>
</tr>
<tr>
<td>1</td>
<td>15 (14.6)</td>
<td>17 (10.4)</td>
</tr>
<tr>
<td>2</td>
<td>5 (4.9)</td>
<td>2 (1.2)</td>
</tr>
<tr>
<td>≥3</td>
<td>4 (3.9)</td>
<td>1 (0.6)</td>
</tr>
</tbody>
</table>
Prolonged blood pressure reduction by orally active renin inhibitor RO 42-5892 in essential hypertension

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Abstract

Objective—To investigate the effects of a novel specific renin inhibitor, RO 42-5892, with high affinity for human renin ($K_I=0.5\times10^{-10}$ mol/L), on plasma renin activity and angiotensin II concentration and on 24 hour ambulatory blood pressure in essential hypertension.

Design—Exploratory study in which active treatment was preceded by placebo.

Setting—Inpatient unit of teaching hospital.

Patients—Nine men with uncomplicated essential hypertension who had a normal sodium intake.

Interventions—Two single intravenous doses of RO 42-5892 (100 and 1000 μg/kg in 10 minutes) given to six patients and one single oral dose (600 mg) given to the three others as well as to the patients who also received the two intravenous doses.

Results—With both intravenous and oral doses renin activity fell in 10 minutes to undetectably low values, while angiotensin II concentration fell overall by 80-90% with intravenous dosing and by 30-40% after the oral dose. Angiotensin II concentration was back to baseline four hours after the low and six hours after the high intravenous dose and remained low for at least eight hours after the oral dose. Blood pressure fell rapidly both after low and high intravenous doses and after the oral dose and remained low for hours. With the high intravenous dose the daytime (0900-2230), night time (2300-0600), and next morning systolic blood pressures were significantly lowered by 12-5 (95% confidence interval 5-6 to 19-7), 12-2 (5-4 to 19-3), and 10-7 (3-2 to 18-5) mm Hg respectively, and daytime diastolic pressure was lowered by 9-3 (2-2 to 16-8) mm Hg. With the oral dose daytime, night time, and next morning systolic blood pressures were lowered by 10-3 (5-5 to 15-4), 10-5 (4-2 to 17-2), and 9-7 (4-0 to 15-6) mm Hg, and daytime and night time diastolic pressures were lowered by 5-8 (0-9 to 11-0) and 6-0 (0-3 to 12-2) mm Hg respectively.

Conclusions—The effect of the inhibitor on blood pressure was maintained over a longer period than its effect on angiotensin II. RO 42-5892 is orally active and has a prolonged antihypertensive effect in patients who did not have sodium depletion. This prolonged effect seems to be independent, at least in part, of the suppression of circulating angiotensin II.

Introduction

The efficacy of drugs that interfere with the formation of the vasoconstrictor octapeptide angiotensin II is well established. Angiotensin II is formed in two steps. The decapetide angiotensin I is generated from angiotensinogen by the proteolytic activity of the aspartyl protease renin, and then angiotensin converting enzyme converts angiotensin I to II. The beneficial results obtained with angiotensin converting enzyme inhibitors in the management of essential hypertension have stimulated the search for inhibitors of renin, which is the rate limiting enzyme for the formation of plasma angiotensin II.

Detailed knowledge of the tertiary structure of renin has led to the recent advent of high affinity inhibitors specific for renin. These inhibitors, when given intravenously to normotensive subjects, effectively reduce plasma renin activity and angiotensin II. Two such compounds have been shown to lower blood pressure, but this effect was short lived. RO 42-5892 is a novel renin substrate analogue with high affinity for human renin.