The BASES Expert Statement on The Importance of Young People's Aerobic Fitness for Health

Produced on behalf of the British Association of Sport and Exercise Sciences by Dr Keith Tolfrey, FBASES, Dr Mark De Ste Croix, Prof Gareth Stratton, FBASES and Assoc Prof Craig Williams, FBASES

Introduction
Preventive exercise-related strategies targeting the health of children and adolescents (young people <18 years) are required to complement attempts to reduce and prevent disease or ill-health in adults. Aerobic (cardiorespiratory) fitness is regarded as an important marker of young people's health. This is due to its effect on or association with obesity, cardio-metabolic risk factors, diabetes, certain cancers and mental health (Ortega et al. 2008). However, approximately 20 years ago there was a shift in emphasis from fitness towards identifying the most valid ways to objectively quantify physical activity and increase daily habitual activity levels. Technological advancements led to more objective quantification of physical activity and how this might relate to obesity and other lifestyle health problems. Moreover, a tide of opinion suggested that indiscriminate fitness testing and a misguided focus on population level improvement in fitness were diminishing school physical education to the detriment of other important curriculum areas. Subsequently, interest in fitness related to health fell out of favour. Without dismissing the importance of obesity and the role of physical activity per se in paediatric exercise science, we will highlight the critical role of fitness when considering the health of young people. Moreover, we support evidence-based, minimum cut-off values to identify young people with low fitness and increased chance of clustered cardiovascular risk factors. The statement draws on evidence that has measured peak VO$_2$ and other fitness indicators - directly and also indirectly - assessment where young people completed the 20 metre shuttle run test (20-mSRT). While we recognise the distinction between the physiological (peak VO$_2$) and performance (20-mSRT) measures (see Tomkinson & Olds 2007), below the combined evidence supports the importance of fitness, particularly for young people with low fitness levels.

Background and evidence
Several European population-based studies with young people have shown that a lower level of fitness is associated with various indicators of current or future ill-health (see Ruiz et al., 2011), whereas evidence-based, minimum cut-off values to identify young people with low fitness and increased chance of clustered cardiovascular risk factors. The statement draws on studies that have measured peak VO$_2$ and other fitness indicators - directly and also indirectly - assessment where young people completed the 20 metre shuttle run test (20-mSRT). While we recognise the distinction between the physiological (peak VO$_2$) and performance (20-mSRT) measures (see Tomkinson & Olds 2007), below the combined evidence supports the importance of fitness, particularly for young people with low fitness levels.

Cut-off values for fitness
Age, sex and race influence minimum cut-off values for fitness. From a population-based sample of young people, have been proposed recently (Adgoeby et al. 2011). These values can be used to identify children and adolescents of low fitness with a higher propensity for clustering of cardiovascular risk factors. From a sample of 4,500, 8 to 17 year old boys and girls, peak VO$_2$ and standardised combinations of metabolic syndrome were measured. Receiver operating characteristic (ROC) analysis cut-off values that discriminated between low and high cardio-metabolic risk are shown in Table 1.

Table 1. Cut-off values for aerobic fitness

<table>
<thead>
<tr>
<th>Age</th>
<th>Girls</th>
<th>Boys</th>
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<tbody>
<tr>
<td>8</td>
<td>11</td>
<td>37.4</td>
</tr>
<tr>
<td>14-17</td>
<td>33.0</td>
<td>46.0</td>
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Although this is not the first time that cut-off values have been proposed recently (Adgoeby et al. 2011), this study has avoided normative standards based on percentiles and the values are derived from current health markers in a large sample. However, prospective longitudinal studies are needed to examine whether young people below these cut-off values have a greater incidence of cardio-metabolic diseases when they become adults compared with those above these values.

Renewed interest in fitness is a consequence of the global trends that have demonstrated a sustained and significant decline in fitness assessed by 20-mSRT (Tomkinson & Olds, 2007). Comparative data on English children’s fitness, also from 20-mSRT performance, are available from two recent studies. First, fitness was measured annually between 1998 and 2004 and comprised a total sample size of 15621, 9 to 10 year old children from the North West (Stratton et al., 2007). Second,303 children aged 10 to 11 years from the South East were measured in 1998 and compared with 315 children in 2001 (Kendrick et al. 2010). Both studies reported an identical 0.8% annual decline in fitness, which was double the decline reported in global data albeit over 45 years (Stratton et al., 2007). These studies did not measure 2.0 mSRT performance so it is not possible to determine what proportion of the samples fell below the cut-off values proposed by Adgoeby et al. (2011). Nevertheless, the findings suggest that fitness monitoring and enhancement of some young people is advised and the identification that 20-mSRT cut-off values would be useful for practical reasons.

Relationship of body size and fitness
Part of the interplay between fitness and body size is the effect of increasing body (fat) mass in children over the last 15 years. It well recognised that body size and fitness share a strong association particularly in weight bearing modes of exercise (i.e., walking or running). Stratton et al. (2007) divided their sample by sex and BMI and found that fitness declined year on year regardless of low average or high BMI category. Sandercock et al. (2010) concluded that the decrease in fitness was largely independent of changes in BMI after finding that BMI did not change over the 10 year observation period and only a small change existed for boys’ BMI. Collectively, these studies show that changes in fitness do not merely reflect an increase in body size but also that lean and overweight children have experienced reductions in fitness. Moreover, there is evidence of a divergence between the least and most fit. In adults, exercise training results in enhanced fitness – particularly in low fit individuals. The commonly reported blunted trainability of young people’s peak VO$_2$ may limit the sub-optimal exercise programmes that are too short and lack adequate intensity (Tolfrey, 2007). Those without the lowest pre-intervention fitness demonstrate the greatest gains (Tolfrey, 2007). However, disassociation persists in the literature with low fit children and adolescents avoiding studies aimed at enhancing fitness. Therefore, exercise programmes designed to increase fitness should be targeted at low fit, young people, below the cut-off values, rather than used universally (see Table 1).

Recent fitness debates
The UK Chief Medical Officer suggested recently (Department of Health, 2010) that comprehensive physical fitness testing should be piloted in secondary schools. We share some of the concerns about indiscriminate mass screening of young people and support a more targeted approach. An above average (peak) VO$_2$, directly or indirectly, but only if the primary objective is an educational achievement. Although schools are required by law to provide the fundamental movement skills and a variety of positive exercise and sports experiences, we believe the combined evidence supports the importance of fitness, particularly for young people with low fitness levels.

Practical recommendations
• Identify low fit young people using the 20-mSRT initially and then confirmed with direct measurement of peak VO$_2$.
• Recognise that low fit young people need a vigorous exercise programme to improve their fitness that includes a variety of exercise modes (continuous and intermittent), at least 3 sessions per week, 85 to 90% of maximum heart rate, 30 to 60 min duration, and lasting at least 3 months.
• Provide young people, particularly those with low fitness, with more opportunities for vigorous physical activity and structured exercise.
• Recognise that an activity skill-set, from high quality physical education provision, is required to engage fully in an active life-style.
• Help responsible adults to appreciate that the baseline level of fitness all young people should be aiming for is for health purposes rather than for competitive sports participation, although it may eventually support participation.
• Encourage all young people to be physically active and aspire to attain international recommendations for daily accumulated activity.
• Recognise that the influence of fitness and a balanced, nutritious diet and energy intake must be considered in combination.

References
Department of Health (2003), Treadmill-based measurement of VO2, www.bases.org.uk

Dr Keith Tolfrey FBASES is a Senior Lecturer at Loughborough University and is Director of the BASES Division of Physical Activity for Health.

Dr Mark De Ste Croix is a Reader at the University of Gloucestershire and Honorary Consultant at the West Midlands Paediatric Exercise interest group. He is a BASES accredited sport and exercise scientist (Research) at</p>