Fitness Testing for Children: Let’s Mount the Zebra!

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Childhood obesity has increased greatly over the past few decades, while children’s fitness levels have been declining worldwide. Physical fitness, a multidimensional construct that includes skill and health related components of which cardio-respiratory fitness (CRF) and muscular fitness in particular are powerful determinants of health in youth. The association between fitness and health is well documented for CRF, whereby good CRF is protective against cardio-metabolic risk factors across BMI/fatness categories. Muscular fitness is also inversely associated with metabolic risk and is a valuable part of health monitoring in children. Specifically, poor muscular fitness is associated with elevated cardio-metabolic risk factors in adolescence and an increased risk of developing obesity, cardiovascular disease and with cardiovascular and total mortality. This effect appears independent of the associations between metabolic health and low CRF.

Given such strong, independent associations between fitness and health, declines in pediatric fitness are worrying from a public health perspective and underpin the former UK Chief Medical Officer’s (CMO) recommendation for routine fitness testing in schools. The CMO stated that “the introduction of a standardised school-based fitness assessment in England may have multiple benefits that extend beyond the benefits for the individual.” These benefits include: lowering the lifetime risk of 6 diseases, building a lifelong habit of participation in physical activity, higher educational achievement, maintaining a healthy weight, as well as improving social and mental wellbeing. Field-tests of fitness, such as Leger’s 20-m shuttle run test (or “bleep test,” “beep test,” “PACER,” “multistage fitness test”) used to estimate CRF, as well as hand grip strength, jump performance, and/or trunk muscular endurance to assess muscular fitness, particularly lend themselves to school-based assessments due to relatively low space and equipment requirements. More importantly, because they are often already, or can be easily integrated into Physical Education (PE) lessons. In part, the UK CMO’s recommendation for school-based fitness testing builds upon a variety of well-reported school-based fitness projects, and the wealth of information that these have yielded. For example, the FITNESSGRAM fitness testing battery is implemented annually in a number of US states and in New York City public schools, while the ALPHA fitness testing battery based on the pan-European HELENA and Spanish A VENA studies has been successfully piloted in Spanish schools. In the UK, in addition to being implemented sporadically in schools, youth fitness testing is implemented regularly by fitness professionals in conjunction with academies from Liverpool John Moores University, as part of the on-going research and health promotion program: SportsLinx.

More recently, our group from the University of Essex launched the East of England Healthy Hearts Study, which included comprehensive fitness testing for 10- to 16-year-old children during PE classes at schools in London, Essex, Suffolk, and Bedfordshire (UK counties). The study allowed for the development of various fitness test norms and revealed declining trends in fitness norms and a number of mediating factors. Furthermore, the Texas Youth Study based on fitness assessment of over 2.5 million children revealed positive associations between fitness and academic achievement, school attendance, several psychosocial measures and negative associations with indicators of delinquency. While much of these data are not new, one should not ignore the potential value of media coverage of these physical and cognitive or behavioral correlates of fitness and highlighting regional differences as leverage to promote governmental action on physical activity (PA).

While few would argue against the value of monitoring trends in children’s health, routine school-based fitness testing is not greeted with approval by all. The Association for Physical Education and parent groups criticized such plans for the UK, echoing concerns about fitness testing in children aired in the academic literature. One specific concern is the potential for fitness testing to be an unpleasant and embarrassing experience for overweight children, as embarrassment or teasing by other children is indeed an important concern. While there is little empirical research examining children’s experience of fitness testing is under-researched, there is indeed some evidence to suggest that there may be negative psychosocial consequences, such as embarrassment or teasing by other children. Since physical self-concept is a determinant of PA, this is indeed an important concern for school-based fitness testing. In addition, fitness testing has also been criticized for not promoting PA per se, yet even its strongest advocates do not regard this as an expected outcome of the process. For example, the National Child Measurement Program, which assesses BMI in UK schoolchildren, does not cite weight loss as an objective of the measurement process but rather “to inform local planning and delivery of services for children.” Since physical self-concept is a determinant of PA, this is indeed an important concern for school-based fitness testing. In addition, fitness testing has also been criticized for not promoting PA per se, yet even its strongest advocates do not regard this as an expected outcome of the process.

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Fitness Testing as a Zebra

Based on the aforementioned concerns, as well as additional concerns regarding fitness tests validity, use of criterion standards or inappropriate use of data, a number of authors have challenged the value of youth fitness testing and likened it to a dead horse, from which “it is time to dismount.” Other authors, in keeping with the metaphor of a horse, have defended youth fitness testing, asserting that its value depends on the skill and training of the riders.
or the understanding that is not a horse, but a zebra that is being ridden. The zebra’s stripes symbolize the potential for fitness testing to have multiple applications and outcomes, including a role in the development of “physical literacy, a multidimensional and interactive construct.”

We argue that the principal aim of youth fitness testing, which is the mapping and tracking of trends in fitness, is of substantial value and provides data beyond that of BMI alone. This contributes to the surveillance of youth health and to the evaluation of the effectiveness of PA promotion strategies and can inform school curricula or policies. While fitness testing itself may not promote increased PA and fitness, improvements in fitness measures could detect increases in the quantity and quality of school PE or PA overall, and provide an noninvasive objective assessment of the physiological impact of interventions. Both cross-sectional and longitudinal fitness data may also provide convincing empirical data and thus impetus for legislative action to support programs aimed at PA promotion and obesity prevention.

Further, we believe that the delivery and contextualization of youth fitness testing and provision of feedback, or “the skill of the rider,” could transform the horse into the zebra which can achieve improved health, as well as psychosocial and educational outcomes. We argue that youth fitness testing can be a vehicle both for the promotion of PA and the development of physical literacy and it can do so without undermining physical self-concept in overweight children. However, these outcomes are not an inevitable consequence of fitness testing and we urge for diligence when selecting fitness test batteries, as well as when providing feedback.

We now highlight issues which we believe are important for the design and delivery of youth fitness testing, with the aim of achieving objectives beyond surveillance while addressing concerns about negative psychosocial outcomes and lack of contextualization.

Fitness Testing and Physical Self-Concept

We acknowledge that fitness testing has the potential to negatively impact on the physical self-concept of the overweight (or unfit) child. Although there is little empirical evidence to support this notion, there are limited reports of negative psychosocial consequences of fitness testing, such as embarrassment or teasing by other children. More specifically, a survey of more than 2500 PE teachers reported such incidents. Physical self-concept is a determinant of PA, and we emphasize that it is essential to minimize such negative experiences and ensure that for less active or overweight children—those for whom increased levels of PA and fitness are most important—fitness testing does not undermine physical-concept. We further believe that this outcome is not an unavoidable consequence of the process and we argue that fitness testing could, on the contrary, be a means to enhance the physical self-concept in such children.

Fitness testing can also be a vehicle used to challenge pervasive and potentially harmful assumptions about the relationship between body size, health, and fitness. In particular, it challenges the notion that being overweight is incompatible with being fit and healthy, while thinness equates to good health and fitness. For example, Bacon and Aphramor recently reported that 51% of overweight adults had ‘normal’ cardio-metabolic health, whereas 24% of normal weight adults had ‘abnormal’ cardio-metabolic health, illustrating the limitations associated with using BMI alone as a proxy for health. Similarly, evidence from the Aerobics Longitudinal Study long ago introduced the ‘fat-fit’ phenomenon, whereby overweight but fit individuals had a lower risk of cardiovascular mortality than normal weight but unfit individuals. This phenomenon is also observed in youth, where higher fitness is associated with lower cardio-metabolic risk factors in children classified as normal and overweight by BMI. Furthermore, Parrett et al found that in children with body composition assessed by DEXA, higher % fat children with high aerobic fitness had significantly lower metabolic risk score than their low fitness, higher % fat counterparts.

Indeed, based on the work of Blair and others, it is now widely agreed that differences in fitness and PA contribute greatly to the variability in cardio-metabolic health observed at any given BMI. To further illustrate this point, we cross-tabulated the prevalence of children with varying levels of CRF according to BMI weight status from our East of England Healthy Hearts Study dataset (Figure 1, Panel A). As expected, low CRF was typically higher in overweight and obese children compared with normal-weight children; yet, our data also revealed that ~50% of overweight and a smaller proportion of obese children were in the middle and top tertile of CRF. By not testing them, we deny ‘fat-fit’ children an opportunity to demonstrate their adequate levels of CRF and thus positively reinforce the healthy PA behaviors that presumably underlie this trait. In addition, the notion that fitness testing does not provide additional information to BMI reinforces the false assumption that normal weight or thinness equates to good fitness, or indeed health. According to our findings, the proportion of unfit normal weight children is lower than the proportion of unfit overweight children (Figure 1, Panel A), but overall, there was a greater number of normal weight unfit than overweight unfit children (n = 855 vs. n = 615). This further highlights the importance of communicating to normal weight children, and perhaps more importantly their parents, that their levels of PA or fitness are inadequate. To add to this, we previously reported significant secular declines in CRF and muscular fitness in English 10-year-olds over a 10-year period, even though BMI remained stable; these data further call into question the usefulness of measuring BMI alone to monitor youth health.

The Importance of Muscular Fitness Tests

It appears that in the debate in the UK over youth fitness and fitness testing, ‘fitness’ has become synonymous with cardio-respiratory fitness (CRF), with critics referring to the ad hoc way in which the 20-m shuttle-run is implemented in British schools. In this context, the multidimensional nature of fitness cannot be emphasized enough and an opportunity to give overweight children fitness-related positive feedback is potentially missed if only CRF and weight-bearing tests of muscular fitness are administered. Overweight children tend to outperform normal weight children in nonweight bearing tests of strength and power, such as hand grip strength (Figure 1, Panel B), medicine ball throw or in weight bearing strength and power tests when performance is expressed with relative values (Figure 1, Panel C).

Morano et al. reported a bolstering of physical self-esteem in overweight children when tested with the medicine ball throw; a measure of upper body power. We can anecdotal confirm observing a similar effect in the East of England Healthy Hearts Study for hand grip strength testing. Indeed, muscular strength is one of the only subcomponents of physical self-concept scales on which overweight children rate themselves highly. Highlighting these pupils’ capabilities in this specific aspect of fitness through testing could be a way to positively reinforce a specific “athletic identity.” This construct