

EDITORIAL

Exercise training and physical activity in children: Hard interval training or low hanging fruits to ensure normal growth and maturation for the sake of lifelong physical activity?

Physical activity but also exercise training is considered vital in children for their normal growth and maturation. Physically active lifestyle is important for health and exercise training if children have competitive aims. But how should they train, especially if children (or parents and coaches as might often be the case) want to improve their abilities in endurance sports? Answers to this question are provided by Grendstad and Hallen who studied the effects of adding high-intensity exercise training on maximal oxygen uptake in 12-year-old youth cross-country skiing athletes.¹ The study lasted 8 weeks and one group of children trained on average 4.6 times per week of which two training sessions were high-intensity interval sessions. This group was compared with a group called strength and coordination group who trained 4.1 times per week and control group which consisted of 29 Norwegian children who exercised 1.8 times per week. None of these latter groups performed high-intensity training. Essentially what they report is that maximal oxygen consumption (VO_{2max}) increased similarly in all of these groups no matter how children trained or did not train. These findings have important implications to training practices as they suggest that high-intensity training is not required in children, and it does not provide additional benefits for VO_{2max} as compared to normal active living or other type of training which do not focus on endurance. Although it is good to train at all exercise intensities and to learn to perform also high-intensity training when young for later if success in competitions is the goal, but as it is often considered also both physically and mentally quite demanding, training mainly by other means might provide more participation and enjoyment, which eventually might also lead to better outcomes in major issues in children sports such as dropout.^{2,3} The study by Grendstad and Hallen also suggests that focusing on other type of training does not either compromise the development of VO_{2max} if the main interest is in the endurance sports. Higher intensity

training is often required for further development when fitness is high but concentrating more on “low hanging fruits” such as general active lifestyle and training various (motor) skills, technique, speed, agility, jumps, strength, balance, and coordination might develop more balanced and prepared body^{4,5} for development and harder training later in adolescence and adulthood. This might also better reduce sports-related problems in youth such as overuse injuries^{6,7} when training is not monotonic and too intensive. This approach also creates good abilities to try and learn new sports later in life.

Grendstad and Hallen¹ reported VO_{2max} not only as absolute numbers but also relative to total body weight and fat-free mass (FFM) as is required to make the best possible physiological interpretations independently of confounding adipose tissue factor.^{8–10} Their results indicate that FFM-normalized VO_{2max} did not actually change in any group, suggesting that normal growth and maturation are far more important factors for VO_{2max} change than training in children. What actually happened was that as body composition also changed toward a leaner phenotype, increased total body weight normalized VO_{2max} values were basically simply the result of the less body fat. This is very interesting as unchanged FFM-normalized VO_{2max} values, which mostly although not solely likely represent active skeletal muscle tissue that consumes oxygen, suggest that exercise training even in the high-intensity group did not improve oxygen utilization at all in muscles. This might be suggestive of central (cardiac) oxygen transport limitation also in children. Professor Hallen and colleagues have also earlier studied the development of heart in children and adolescents and interested reader is directed to these publications for further information.^{11–14} In these studies, heart was studied by echocardiography, but there might also be training-induced changes in other variables such as reduced blood flow and increased oxygen extraction and blood mean transit time at rest and during submaximal

exercise,¹⁵ which have not yet been elucidated in children, but which also could partly contribute to high cardiac performance to reach high $\text{VO}_{2\text{max}}$. Further, cardiac adaptations in young male cross-country skiers at 18 years old¹⁴ such as left ventricle mass normalized for body surface area is still approximately half of that which highly trained male cross-country skiers present at the age of 25 years.¹⁶ Thus, there is still usually a long way to go from young adult to adult athlete especially in endurance sports.

In terms of performance, Grendstad and Hallen¹ importantly report that time to exhaustion was improved in the interval training group despite no additional benefits in $\text{VO}_{2\text{max}}$. Time to exhaustion in high-intensity interval group in progressive treadmill test improved by 30s, reaching the same 5.5 min exhaustion time as strength and coordination group, which did not increase their exhaustion time after 2-month training. Thus, in regard to performance, high-intensity training appears to provide additional benefits to be more successful in competitions, for which $\text{VO}_{2\text{max}}$ is not the only contributing factor. Similar and actually even more marked performance-improving findings have been previously reported by the same group by endurance training.¹⁷ In this study, young athletes were followed and tested when they were 12, ~13.5, and 15 years old.¹⁷ Endurance-trained boys had higher $\text{VO}_{2\text{max}}$ at all time points, but increased their time to exhaustion almost 3 times more than non-endurance-trained boys.¹⁷ Interestingly, performance did not change over time in girls, and neither did total body mass and FFM-normalized $\text{VO}_{2\text{max}}$ results in boys, despite the training. Thus, regarding physical performance, training might still matter, even if $\text{VO}_{2\text{max}}$ is not improved.

Finally, it can be considered whether performing more high-intensity training sessions (3–4 times per week) and longer training period could improve also $\text{VO}_{2\text{max}}$ better. It namely appears that training three times per week, 1 h per session where heart rate is above 80% of maximal heart rate for 25–35 min per session, is required to show improvements in $\text{VO}_{2\text{max}}$ in prepubertal (10–11 years old) boys and girls.^{18,19} Another question is whether we even want to promote such intensive training and whether performance and success should even be high in the priority list in children sports as there is competition present already almost everywhere in the society. Recent studies have namely also shown that successful junior and senior athletes are largely two different populations²⁰ and there is thus time to reach high performance whether someone really wants it. We should seriously (re)-consider whether competitiveness is the thing we want to promote, or overall physical activity to get children physically active in a large scale. The ultimate goal in youth participation in sports should be to promote lifelong physical activity and recreation. Organized sport is also not the only way to go as children are also free to play or walk

or jog together which should be recommended and encouraged. In this respect it is worth mentioning that in the study by Grendstad and Hallen¹ children in the control group obtained light physical activity ≈ 3 h per day, 64 min moderate intensity activity, and 5 min vigorous intensity physical activity. This was thus the amount of physical activity that enabled their $\text{VO}_{2\text{max}}$ to develop similarly as in the two exercise training groups. Based on this, it can be concluded that slightly more than 4 h of physical activity per day, including some moderate-to-vigorous intensity activity too, is good goal for children to ensure that their normal growth and maturation as well as fitness develop well in youth. This is important for counteracting worrying global trends in physical (in)activity and fitness in young people.^{21,22} It is not forbidden for adults either to try to accumulate as much as possible daily physical activity, in one way or another, to maintain or even increase physical fitness still in adulthood and aging.

CONFLICT OF INTEREST STATEMENT

None.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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