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Current topic

Controversies about intensive training in young athletes

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In the past few years increasing concern has been expressed about the possible harmful effects of intensive training in young athletes. In gymnastics, swimming, and tennis children in their early teens have already been undergoing intensive training and high level competition for some four or five years. Due to the increasing emphasis on competitive success it is widely believed that, in order to achieve a world class standard at senior level, it is necessary to commence intensive training well before puberty. This emphasis on early specialisation in a single sport with its accompanying intensive training and high level competition begs the following questions: have young children the physical, physiological, and psychological capabilities for intensive training and high level competition? Is there an increased risk of bony and soft tissues injuries in the developing musculoskeletal system?

Physical and physiological effects

The effects of training are difficult to separate from those of normal puberty.[1] Results are conflicting: some studies have described growth retardation,[2] and others no detectable effects.[3–6] Most studies conclude that a certain amount of physical activity is required for normal growth, but fail to identify what the minimum is and what, if any, are the disadvantages of intensive training.[1–6]

A topic of great interest is the age of achieving menarche and the incidence and duration of menstrual disturbances in young athletes engaged in intensive training. Malina concluded that, with few exceptions, menarche is delayed in athletes,[4] and Bonen and Keizer have identified an increased frequency of menstrual irregularities in female athletes.[5] The data dealing with this issue are limited, however, and not well controlled as they have not taken into account other factors that could influence the time of menarche, such as genetic influences or nutritional state.

Kotulan *et al* followed the skeletal maturation of young male athletes engaged in cycling, rowing, and ice hockey from 12 to 15 years and concluded that regular physical activity had no effects on their growth.

The training response of a given athlete is associated with an inherited genotype. It has been shown that about 30% of the final maximal oxygen uptake (VO_2 max) and maximal force and power of top class competitors can be accounted for by training.[7]

Ekblom found that young athletes undergoing vigorous training were taller, had less body fat, and higher VO_2 max than controls.[8] More recently Sundberg and Elovainio compared 34 boys aged 12–16 engaged in competitive middle and long distance running with 56 controls not undergoing intensive training.[9] The runners had been training for two to five years and tended to have less body fat and lower resting heart rate, but the difference only achieved significance at 16 years. At this age runners also had larger heart volumes, as assessed using a roentgengraphic method, and a higher VO_2 max relative to body weight and respiratory capacity.

Fournier *et al* studied the effects of sprint and endurance training on the vastus lateralis muscles of boys of 16 and 17 years.[10] They showed that endurance training resulted in an appreciable increase of type I and IIA fibre areas, together with increased activity of some of the enzymes of the Kreb's cycle. Sprint training resulted in an appreciable increase in the activity of glycolytic enzymes only.

There have been a number of reports of a fatigue syndrome in top class athletes. No controlled studies have been performed, however, and most are anecdotal in type. Possible mechanisms include an increased predisposition to viral infections, fatigue due to overtraining, or a combination of physical and psychological fatigue analogous to the 'burn out syndrome' reported in other contexts.[11–13]

Injuries

Because of the presence of growth cartilage, and the process of growth itself, the bones and joints of a young athlete are more prone to specific types of injuries.[14] In children ligamentous structures are two to five times stronger than the cartilage and the bone of the epiphysial plate to which they are attached,[15 16] resulting in a greater likelihood of fracture of the epiphysial-metaphysial junction rather than the ligamentous tear more commonly seen in adults.

Overuse injuries are a condition characterised by chronic inflammation due to repeated microtrauma. Young athletes undergoing prolonged repetitive activity may develop osteochondrosis,[17] a group of diseases involving degeneration of the centre of ossification where a major tendon attaches to the apophysis of a bone. Common sites are the lower pole of the patella (Sinding-Larson-Johansson syndrome), the tibial tubercle (Osgood-Schlatter disease), the posterior aspect of the calcaneus (Sever's disease); the small carpal and tarsal bones may also be affected. Some studies have shown that young athletes are at greater risk of developing stress fractures, and, in childhood, compression stress fractures occur rather than the oblique type commonly seen in adults.[18 19]

After a careful analysis of training regimens it has been estimated that at least 60% of all injuries sustained were in direct relation to training and could be avoided by appropriate changes in training programmes.[14]

A central issue is whether an alteration of training regimen after an injury can maintain fitness and ensure rapid healing. Very little research has been performed in this area, although Moroz and Houston have recently shown that the replacement of endurance running with endurance cycling for four weeks can maintain maximal aerobic power and submaximal running performance for moderately trained women runners.[20]

Psychological effects

The most serious concerns have been the increased stress and anxiety due to competition,[21] the influence of parents on performance,[22] and the incidence of aggression in young athletes.[23] These concerns have even led to a call for a complete ban on high level competitive sport in preadolescence because of the possible long term deleterious effects,[24] and have also resulted in a change in emphasis from competitive to participatory sports in some education authorities. Detailed reviews of the psychological effects of intensive training on young athletes have recently been published.[25 26]

Conclusions

Definitive statements about the effects of intensive training on young athletes cannot yet be made. Cardiovascular and muscular responses to training in children appear to be similar to those found in adults and, in the short term at least, would appear to be beneficial. Concerns about physical and psychological injury remain, however, and it is likely that the age of the child and the particular sport should influence the type and intensity of training.

Young athletes are not just smaller athletes, and they should not become sacrificial lambs to a coach's or parent's ego. Paediatricians and others dealing with young athletes should be aware of these concerns, and, until more definitive studies are performed, the 'not too much and not too soon' rule should apply, although it must be admitted that it remains unclear as to how much is 'too much' and how soon is 'too soon'.

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