

Strength and Conditioning for Youths

Introduction

The use of strength training with children and adolescents is often mistaken as unsafe and inappropriate for a range of unfounded reasons. Although this mindset is gradually dispersing, you may be aware of some of the more common concerns that are sometimes raised by parents, teachers and coaches:

- “Strength training will expose children to injury”
- “Lifting weights will stunt growth and halt natural development”
- “Some children already participate in sport 4 times a week...they don’t need strength training”
- “They are too young to begin strength training!”

Despite these outdated misperceptions, there is an extremely compelling body of evidence* that *supports* the use of strength training to elicit health benefits in paediatric populations, with a fundamental emphasis on **enjoyment, preventing injury, eliminating obesity and optimising performance**. In fact, it is arguable that youths who do not participate in activities that promote muscle strength and movement skill may be at an increased risk of negative health outcomes in later life.

The strength and conditioning (S&C) team at Surrey Sports Park aim to work alongside parents, schools and sports clubs to encourage the growth of youth athletic development programmes in Surrey, with a view to provide services based around educating the importance of S&C and enhancing health and performance factors in children.

The purpose of this document is to dispel the myths surrounding S&C for youths. It will deconstruct the common concerns shown above, reinforce the safe and fun principles of youth strength training, and will explore the abundant physiological and holistic benefits of S&C.

* The journal articles used to scientifically reinforce this document can be found on Page 12.

What is Strength and Conditioning?

Strength and conditioning is about more than lifting weights – it encompasses the entire development of the athlete and what is needed to improve physical performance. This includes plyometrics, speed and agility, endurance and core stability with strength being just one piece of the jigsaw.

- English Institute of Sport

Using the term ‘S&C’ traditionally covers the combination of strength training (adding resistance to single-, multi-joint and multi-planar movements) and metabolic conditioning (exercises intended to increase the storage and delivery of energy for any activity – or “endurance”). However, it must be highlighted that S&C is a multi-faceted method of training, and does not just concern these two principles. As expressed by the English Institute of Sport (EIS) above, athlete development depends on a multitude of different physical qualities, and can be achieved with a varied youth S&C programme. Typically, if sensible exercise prescription and technical progression are applied, then these physical qualities can be developed with a combination of various training modes, including:

- free weights (e.g. barbells, dumbbells, kettlebells)
- bodyweight exercises
- exercise bands
- medicine balls
- “plyometrics”
- sleds/prowlers
- slide boards
- speed, agility and quickness drills
- small-sided games

With regards to S&C for paediatric populations, these methods are still considered suitable. However, it must be made very clear that simply adapting an adult training programme to suit a child will not only produce poor results, but will likely increase injury risk. An S&C programme that is consistent with the needs, goals and abilities of youths are not only safe and fun, but will reduce injury incidence, elicit noticeable improvements in motor skills, and improve and maintain psychosocial wellbeing.



Qualified professionals who are skilled in teaching youth are a fundamental requirement for successful youth training programmes

Creating Youth Strength and Conditioning Programmes

Due to the highly individualised nature of childhood development, youths of the same chronological age will significantly differ in biological status. This discrepancy can often equate to 4 to 5 years in age difference, which can have adverse effects on participation, enjoyment and performance within a group of children of the same chronological age. For example, the two boys on the left are categorised in the *same chronological age group*, yet there is a marked difference in their



Who is ‘older’?

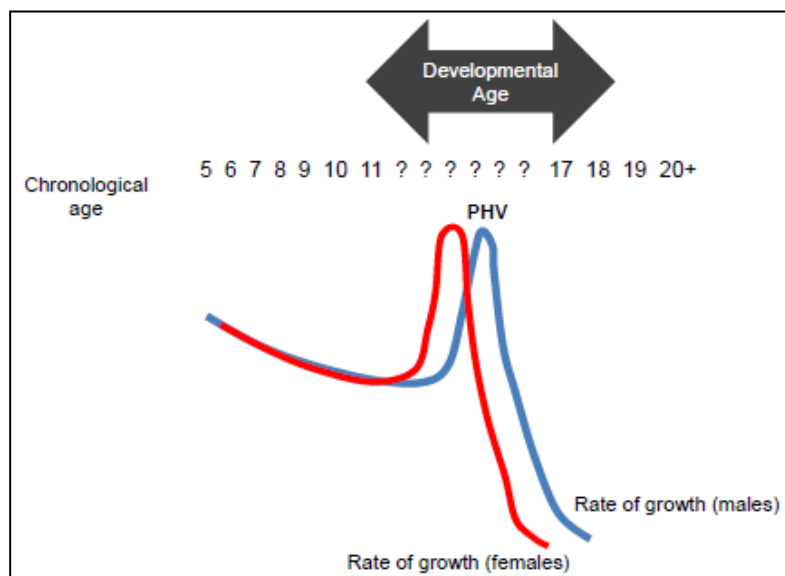
Due to the advantages of being an ‘early maturer’, the boy on the right is likely to receive much more attention and coaching, despite having the same long term potential as the boy on the left. It is also possible for them both to lose motivation, as early maturers may find the training too easy, whereas late maturers may find it too challenging.

As a result, chronological age is considered a poor indicator of maturational status. At Surrey Sports Park, we prescribe exercise according to the unique demands of the individual. These demands are dictated by certain developmental qualities of the child - not only biological status, but also training experience, motor skill competency, technical proficiency, existing strength levels and psychosocial maturity. In doing so, the youth S&C programmes we design promote an optimal development pathway for physiological and holistic development.

To determine these developmental qualities, youth athletes will usually undertake an informal and fun **screening process**. This way we can identify all of the athlete’s strengths and weaknesses according to the norms expected of their maturational age, and advise their relevant supervisors as to what their next steps towards *long term athletic development* should be. The next section of this document will underpin the principles of a long term development model, and how it can be used to optimise the developmental processes that youths naturally experience.

Long Term Development of Young Athletes

One of the main principles of youth physical development is establishing individual maturational rates and prescribing exercise according to this (and other developmental factors). The archetypal determinant of this is the individual's **peak height velocity** (PHV). This represents the fastest rate of growth in stature during their 'spurt', and is formulated using four non-invasive measures - seated height, standing height, body mass and chronological age. The individual's maturational age can then be established, usually displayed as how many years prior to or beyond PHV they are (i.e. maturity offset = $\text{PHV} \pm ?$ years).



Typical PHV occurrences for males and females (in reference to chronological age)

Maturity offset can be used to identify when the training of each fitness component should be emphasised. Training for all components of fitness can be considered for children of all ages, with certain components taking priority over others during particular stages of maturation. **It is now scientifically recognised that most, if not all, physical qualities are trainable throughout childhood and adolescence.** These include:

- fundamental movements (bending, jumping, squatting...)
- mobility & flexibility
- agility
- speed
- power
- strength
- muscular growth (hypertrophy)
- endurance & metabolic conditioning

Previous models of long term athletic development have suggested that vital “windows of opportunity” exist during the developmental years, whereby children and adolescents should train some physical qualities, but not others. This claim does however lack longitudinal scientific backing, and should be regarded with caution when creating training programmes for young athletes.

The Benefits of Strength and Conditioning for Youths

*Physical inactivity is recognised as the fourth leading risk factor for global mortality for non-communicable diseases, and participation in a variety of physical activities, including those that **strengthen muscle and bone**, is encouraged.*

- World Health Organisation

Unfortunately, most youths nowadays fail to meet current recommendations for daily physical activity. If preventative care is not swiftly taken, it is suggested that the current situation could develop to a pandemic of physical inactivity, whereby the dangers of exercise deficit could become as politically prevalent as obesity and smoking. **Physical activity is essential to normal growth and development**, and youth programmes that enhance fundamental movements and muscular strength appear to have long term implications for health, fitness, self confidence and sports performance in later life.

1. Health Benefits

S&C can offer a plethora of unique health-related benefits, with an evident influence on metabolism, insulin sensitivity, body fat levels, cardiovascular risk factors and muscle and bone wellbeing. Given the pervasiveness of childhood obesity and risks of being overweight, youth S&C has received increased attention and is growing in popularity.

In the past, it is has been common to prescribe aerobic exercise (such as jogging) to overweight and obese youth. This is actually considered detrimental, as this population are twice as likely to injure themselves during this type of activity due to the hindrance of excess body fat and significantly lower motor coordination. S&C can form part of a multi-faceted treatment programme to help combat weight issues, as well as help improve confidence in perceived abilities to be physically active. Available evidence indicates that this type of training has the potential to offer observable health value to sedentary youths, and can be prescribed to meet the needs of all children and adolescence, regardless of shape and size.

2. Injury Prevention Benefits

Integrated hamstring strength training during pre-season and in-season conditioning has been associated with reduced knee ligament injuries in young athletes, as well as reduced incidence of hamstring strain.

- United Kingdom Strength and Conditioning Association

Without qualified instruction, directed movement practice, and a sensible progression of age-appropriate activities, physically inactive children are less likely to become as motorically competent as adults. This is likely to increase injury incidence in young populations. Preparatory strength training can offer a significant prevention effect in youth injury rates; addressing risk factors such as low fitness levels, muscle imbalances and error in training has the potential to reduce these rates by up to 50%. Although the total elimination of injury is unrealistic, at Surrey Sports Park we feel that injury prevention regimens form a fundamental part of a multi-faceted S&C programme.

In particular, special training considerations must be taken when working with young females. It can sometimes take a while for the nervous system to catch up with the rapid muscle and bone growth that occurs during puberty, and from a biomechanical point of view this can lead to poor movement mechanics – a serious injury risk factor in young females if left unaddressed. Conversely, there is evidence to show that participation in strength training during maturation leads to safer movements and increased strength in young females, which usually results in improved sports performance and can improve biomechanics related to female injury risks.

As a case in point, this picture demonstrates what is known as a **valgus knee position** during a jump or a landing. Females typically demonstrate greater valgus knee during movement than their male counterparts, which is essentially a consequence of having wider hips. Females are therefore at increased risk of ACL rupture. To combat this there are multiple fun, correctional exercises that can be prescribed to young females of all ages, partly to improve neuromuscular function, and partly to strengthen the associated muscle groups around the hips, knees and ankles.



3. Psychosocial Benefits



Children are not mini-adults, any training should consider the unique way in which they respond and adapt

Participating in S&C can be an extremely positive force in a young person's life. Training can have a substantial influence on various emotional and psychological aspects of people of all ages, namely **self-image**, **self-esteem**, **body cathexis** and **general outlook on life**. Psychological well-being and character development are essential factors in youth, and from this perspective it is important to encourage children to participate in physical activity that is satisfying, enjoyable and rewarding. Sport in itself has long been recognised as a "life in microcosm", whereby participants are offered opportunities to practice many of the highly prized character traits that are desired in society.

Naturally, level of emotional and intellectual maturity is a key determinant in exercise prescription, and recognising when a child can or cannot handle the rigors of a training programme emotionally is a useful tool for a coach, which is highly valued by the S&C team at Surrey Sports Park. Manipulating programme structure to suit the emotional and intellectual status of youths is one of the fundamental principles of S&C programme design. For example, youths in early to middle childhood would usually be exposed to "training" that accentuates fun, play and games with a typically unstructured nature.

This is in contrast to the training of an adolescent, where the activities would typically take a moderate to high structure, with more emphasis on training volume and intensity factors. This in itself can have a profound effect on psychological and emotional factors, as a monitoring or recording process can provide strong evidence of positive progress. A young trainee who can chart their own development can experience a true sense of advancement, and this is considered indispensable.

4. Performance Benefits

Expected strength gains of 30%-40% are typically observed in young people following participation of an S&C programme.

- United Kingdom Strength and Conditioning Association

Children and adolescents will naturally experience an increase in muscular strength during growth and maturation, without the aid of strength training. However, the development of strength as a result of training can have many important implications for sport and daily life. Research clearly indicates that appropriately designed and well supervised S&C programmes can benefit youths of all ages, and having muscular strength levels above and beyond those of growth and maturation can be extremely advantageous for all developmental stages.

In terms of sports performance, S&C can offer an enjoyable pathway to enhanced athletic ability in later life. Although paediatric S&C coaches may not handle the development of more intricate skills required in sport (e.g. golf swing, pole vault, rowing gait) they are there to provide young people with the tools to perform sport-specific skills with efficiency, confidence and minimal injury risk. Paediatric S&C at Surrey Sports Park endorses the progression of rudimentary physical qualities that many different sports require (as mentioned on Page 4), as well as aiding the physical requirements of daily life.

One sport that has been shown to present significantly less injury incidence than many sports is **weightlifting**. This concerns the performance of the snatch and the clean and jerk, and can be used as an effective training tool for youth athletes. When weightlifting in a properly supervised and safe environment, youths utilise a variety of multi-muscle, multi-joint exercises, which has previously produced positive alterations in body fat levels, cardiorespiratory variables and various motor fitness parameters.



Weightlifting is undertaken in a manner that never compromises the athlete's safety and well-being.

Addressing the Concerns

The common concerns addressed on the Page 1 of this document are a drop in the ocean, and we acknowledge that you may still have many queries that have not been addressed. The purpose of this section is to reinforce that our S&C team are eager to recognise your concerns. If you would like to ask any more questions regarding Strength and Conditioning for Youths, our contact details can be found at the end of the document. However, we hope that the information presented here has been satisfactory and informative.

- **“Strength training will expose children to injury”**

This particular concern is one that we hope this document has effectively dispelled. It is common for a lack of understanding to lead to the assumption that S&C will expose a child to injury. In contrast, this type of training poses no danger to youths if it is safely administered by a qualified professional, and can actually lead to a significant reduction in injury risk. The associated increases in bone density, muscular strength, movement skill competency and self-confidence that are attached to paediatric S&C make it an invaluable pathway for injury prevention in children and adolescents.

- **“Lifting weights will stunt growth and halt natural development”**

Traditional fears that strength training would damage the developing skeleton are noteworthy. Much of the reasoning behind this concern is based on injuries to the epiphysis (the rounded end of long bones). Although it is true that this structural compound is weaker than the surrounding connective tissue, there is no evidence indicating that S&C is especially injurious to the epiphyses or has direct correlation with reductions in growth height in youths, providing that they are supervised by well qualified coaches in a safe and appropriate manner. Contemporary scientific research actually indicates that childhood is the opportune time to build bone mass and enhance bone structure by participating in weight-bearing activities, and that strength training is beneficial to bone formation, density and growth.

Addressing the Concerns (continued)

- **“Some children already participate in sport 4 times a week...they don’t need strength training”**

Owing to the decline in physical activity among children and adolescents, it seems that the musculoskeletal system of some aspiring young athletes may not be prepared for the demands of sports practice and competition. Of concern, research has suggested that physical activity levels in youth peak at approximately 6 years of age, and consistently decline throughout childhood and into adolescence. Consequently, the supporting structures of some young athletes may be ill prepared to handle the demands of weekly sports practice sessions and weekend competitions. Cumulatively, these findings indicate that young athletes should participate regularly in multi-faceted S&C programmes prior to sports seasons to reduce their risk of sports related injury.

- **“They are too young to begin strength training!”**

Muscular strength is a multi-dimensional fitness component that is influenced by muscular, neural and biomechanical factors. Although pre-pubertal youths do not possess the circulating hormones to effect muscular size, muscular strength (as well as the health, injury prevention, psychosocial and performance benefits associated with muscular strength) is still a very attainable quality. This is due to the neural factors associated with strength, and these factors are effectively trainable during pre-pubescence. Owing to this neural plasticity, it would appear appropriate to develop sound movement mechanics and exercise technique during the early years, which can subsequently be exposed to greater external loads during adolescence and the onset of peak height velocity.

Concluding Strength and Conditioning for Youths

To sum up, please use the following 8 points from the UKSCA position statement to reinforce what this document has clearly expressed. If you have any more questions for the S&C team, please don't hesitate to contact us.

1. The use of resistance training by children and adolescents is supported on the proviso that qualified professionals supervise training programmes that are consistent with the needs, goals and abilities of younger populations.
2. Specifically, the use of weightlifting as a resistance training mode by children and adolescents is supported, providing appropriate equipment and logical progressions are prescribed and implemented by suitably qualified personnel.
3. Parents, teachers and coaches should recognise the potential health-related benefits of S&C training, because youths who do not participate in activities that enhance muscle strength and movement skills, may be at increased risk for negative health outcomes in later life.
4. Well designed S&C training programmes are not only safe for young athletes, but may also reduce sports-related injury.
5. An appropriately designed S&C programme can elicit noticeable improvements in motor skills, and consequently may positively enhance sports performance.
6. A properly designed training programme can improve and maintain psychological health and wellbeing.
7. S&C training prescription should be age-related and not age-determined. Consequently, prescription should be based according to biological status, training age, motor skill competency, technical proficiency, existing strength levels, and psychosocial maturity.
8. Regardless of training methods, training volume and intensity should never be increased at the expense of technical competency.

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Primary Reference List

1. Balyi, I. & Way, R. (2005). The role of monitoring growth in long-term athlete development. Retrieved 08/04/2013 from <http://canadiansportforlife.ca/resources/role-monitoring-growth-ltad>.
2. Faigenbaum, A.D., Kraemer, W.J., Blimkie, C.J.R., Jeffreys, I., Micheli, L.J., Nitka, M. & Rowland, T.W. (2009). Youth resistance training: Updated position statement paper from the National Strength and Conditioning Association. *Journal of Strength and Conditioning Research*, 23, S60-S79.
3. Faigenbaum, A.D., Lloyd, R.S., Sheehan, D. & Myer, G.D. (2013). The role of the pediatric exercise specialist in treating exercise deficit disorder in youth. *Strength and Conditioning Journal*, In press.
4. Ford, P., De Stre Croix, M., Lloyd, R.S., Meyers, R., Moosavi, M., Oliver, J., Till, K. & Williams, C. (2011). The long term athlete development model: Physiological evidence and application. *Journal of Sports Sciences*, 29(4), 389-402.
5. Lloyd, R.S., Faigenbaum, A.D., Myer, G.D., Stone, M.H., Oliver, J.L., Jeffreys, I., Moody, J.A., Brewer, C. & Pierce, K. (2012). UKSCA position statement: Youth resistance training. *Professional Strength and Conditioning*, 26, 26-39.
6. Lloyd, R.S. & Oliver, J.L. (2012). The youth physical development model: A new approach to long-term athletic development. *Strength and Conditioning Journal*, 34(3), 61-72.
7. Lloyd, R.S., Oliver, J.L., Meyers, R.W., Moody, J.A. & Stone, M.H. (2012). Long-term athletic development and its application to youth weightlifting. *Strength and Conditioning Journal*, 34(4), 55-66.
8. Lloyd, R.S., Read, P., Oliver, J.L., Meyers, R.W., Nimphius, S. & Jeffreys, I. (2013). Considerations for the development of agility during childhood and adolescence. *Strength and Conditioning Journal*, In press.
9. Oliver, J.L., Lloyd, R.S. & Meyers, R.W. (2011). Training elite child athletes: Promoting welfare and well-being. *Strength and Conditioning Journal*, 33(4), 73-79.
10. Pierce, K.C., Brewer, C., Ramsey, M.W., Byrd, R., Sands, W.A., Stone, M.E. & Stone, M.H. (2009). Youth resistance training. *Professional Strength and Conditioning*, 10, 9-23.