YOUTH
STRENGTH & CONDITIONING
ASSOCIATION

YOUTH
STRENGTH & CONDITIONING
SPECIALIST

YOUTH SPECIALIST
PRACTICAL MANUAL

ACCELERATING YOUR DEVELOPMENT : INSPIRING YOUR SUCCESS

Contents

Effective use of this manual:

This is the Youth Strength and Conditioning Specialist Theory Manual. It highlights key background information, research and optimal guidance to support you when working as a Strength and Conditioning Specialist with young people. Utilise this resource by referencing key concepts with the Course Practical Manual to support you with a full depth of understanding in each key area. This resource identifies the key scientific, research and optimal pedagogical strategies we at the YSCA recommend underpin excellent youth strength and conditioning delivery.

The Youth Movement Journey

'Progressing young people physically over time safely'

The statement above is very concise but it identifies the clear primary goal we as youth strength and conditioning specialists should be aspiring to achieve with all of the young individuals we work with daily. In this section we will present the key themes to help us achieve this objective. We will describe briefly and outline the significant influences, organisations and training models published in the field of youth strength and conditioning and then present the YSCA key guidance for practitioners:

Answering critical questions:

1. ***Is resistance training safe for young people?***
2. ***What history, evolution and consensus are there in relation to LTAD?***
3. ***Who have and are key positive influences in the field of paediatric strength and conditioning?***
4. ***What age should young people start 'training'***
5. ***What intensity should young people train at? How does this evolve over time?***
6. ***How should progressions and regression-'Earning the right to progress' happen?***
7. ***What are the physiological characteristics of young people as they grow?***
8. ***What general 'stage' related training guidance is available?***

Is resistance training safe for young people?

Above is the key question we need to answer. The notion of whether resistance/strength training is ***'safe'*** for young people to participate in? As this detailed section will present ***the answer is a resounding 'yes'.*** However, as with anything there has to be a big caveat attached to that blanket statement: ***All resistance training with young people has to be vigilantly supervised and expertly, appropriately delivered. The content and delivery has to be appropriate to the young person's stage, age mental capacity and physical level of competence***. There also has to be an acceptance of real risk factors and the possibility that poorly administered and supervised programmes can cause injuries in young people and in the worst instance put them at risk. If we accept the responsibility and requirement to be highly skilled, trained and reflective practitioners then we are ready to become youth strength and conditioning specialists.

Resistance training with youth research:

Published statistics have shown that supervised weight training is extremely safe when compared with other sports and activities when it comes to injuries per 1000 hours of playing. Indeed, there are a couple of studies that illustrate this, the highlights of which are shown below:

A 21-month long term study (taken from the **Australian Strength and Conditioning Association's position on youth resistance training)** by Sabres et al 2002**:** which was carried out on males aged 9 and 10, saw the boys engage in regular strength (weightlifting derivatives) training programme, there was only one minor injury reported. The details of which are shown below:

> ***"… On one occasion the bar slid and fell on the thighs of one of the subjects following a lift (clean). The child complained of transient non-specific pain in the anterior thigh and sat out for about 5 min. He returned to train within the same session when the pain was resolved and had no further complications. Therefore, it was felt that no additional medical evaluation was required. The calculated injury rate was 0.055/100 participant hours." (Sabres et al., 2002 p 363)***

Important to note that in this study whilst very encouraging to see young boys progressing well with strength training the sessions were delivered by highly experienced coaches and progressions were carefully administered and loaded.

A study conducted by Brian Hamill of the British Weight Lifting Association reported injury rates in a variety of recreational sports per 100 participant-hours. The results are shown below:

- ***Resistance (strength) training= 0.0035***
- ***Weight lifting for sport= 0.0017***
- ***Soccer= 6.20***
- ***Basketball= 0.3***
- ***Football= 0.1***

(Relative safety of weight lifting and weight training - B. Hamill: Journal of Strength and Conditioning-1994)

Both studies clearly show that supervised weight training is safe for youngsters to engage in regularly in terms of immediate injuries, but what about the long-term effects of strength training with children?

Long Term Considerations:

In November of 2006, an evidence-based review paper: (Clin J Sport Med. 2006 Nov; 16(6):478-87 Weight training in youth-growth, maturation, and safety: an evidence-based review. Malina RM) concluded:

'Experimental training protocols with weights and resistance machines and with supervision and low instructor/participant ratios are relatively safe and do not negatively impact growth and maturation of pre- and early-pubertal youth.'

The American Academy of Paediatrics states in their stance on youth resistance training that:

'A limited number of case reports have raised concern about epiphyseal injuries in the wrist and apophyseal injuries in the spine from weight lifting in skeletally immature individuals. Such injuries are uncommon and are believed to be largely preventable by avoiding improper lifting techniques, maximal lifts, and improperly supervised lifts.

'Strength training programs do not seem to adversely affect linear growth and do not seem to have any long-term detrimental effect on cardiovascular health. Young athletes with hypertension may experience further elevation of blood pressure from the isometric demands of strength training.'

'Strength training programs for preadolescents and adolescents can be safe and effective if proper techniques and safety precautions are followed.'

The RFU (rugby football Union) also states that Strength training may enhance bone development in younger children (Mackelvie et al, British Journal of Sports Medicine 36 2002).

What benefits can be expected?

In a study conducted on junior weightlifters, it was found that Bone mineral content of junior Olympic weight lifters was greater than those who do not lift (Convoy et al Medicine & Science in Sport & Exercise 25 1993, Virvidakis et al International Journal of Sports Medicine 11 1990).

Peer-reviewed research indicates that strength training may be beneficial to young athletes through:

- ***The prevention of injuries***
- ***Improved body composition***
- ***Improved sports performance due to increased strength, power and muscular endurance***

Three studies (references shown below) show the benefits of resistance training in terms of strength- gain and injury- prevention. In preadolescents effective resistance training can enhance strength without concomitant muscle hypertrophy. Such gains in strength can be ***attributed to neuromuscular "learning,"*** in which training increases the number of motor neurons that will fire with each muscle contraction.

It is clear that significant benefits can be gained through incorporating a progressive strength development programme with young athletes. The question is how? How do we put together the sessions? How do we know when to progress?

References:

Kraemer WJ, Fry AC, Frykman PN, Conroy B, Hoffman J. Resistance Training and youth. Pediatr Exerc Sci. 1989;1:336–350 7. Ozmun JC, Mikesky AE, Surburg PR. Neuromuscular adaptations following prepubescentstrength training. Med Sci Sports Exerc. 1994;26: 510 –514. Ramsay JA, Blimkie CJ, Smith K, Garner S, MacDougall J, Sale DG. Strength training effects in prepubescent boys. Issues and controversies. Med Sci Sports Exerc. 1990; 22:605–61

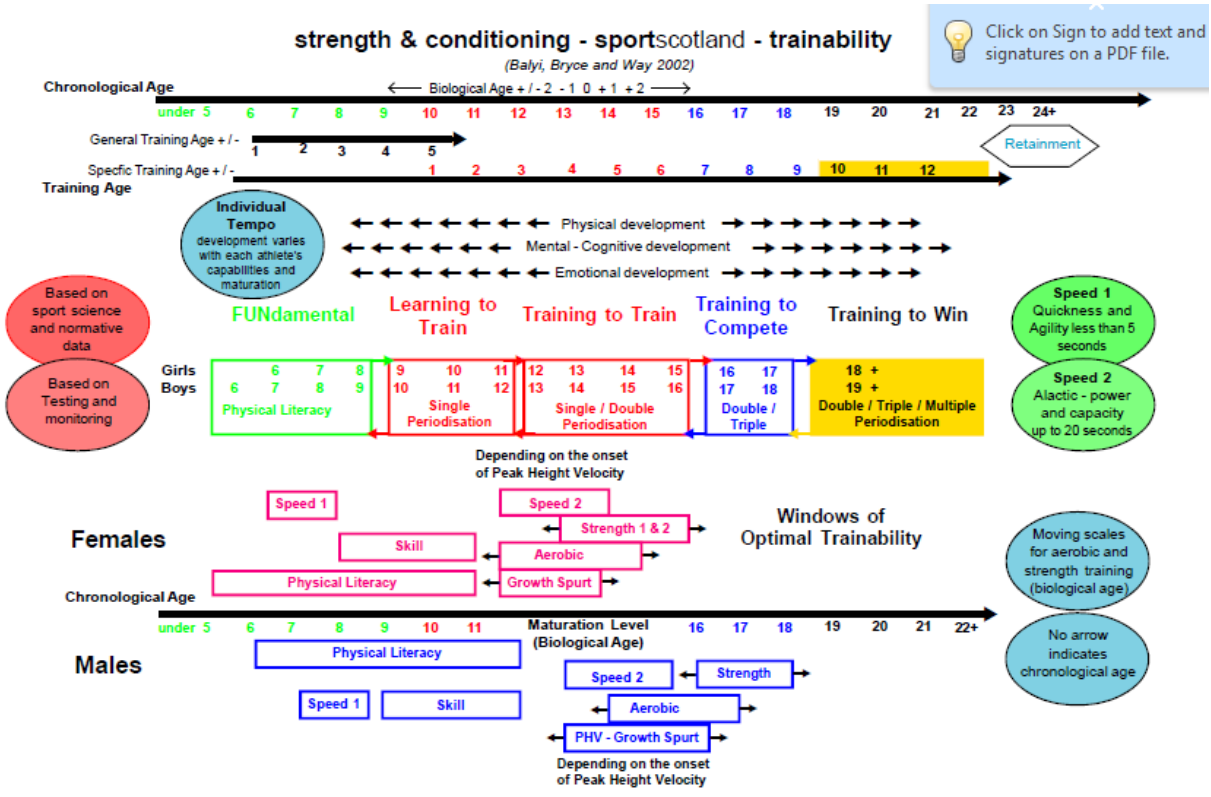
LTAD: *'Long Term Athlete Development Models'-An evolution:*

LTAD is a process or model that allows for optimal physical, psychological, emotional, cognitive and bio-motor development of a child or adolescent. It is achieved through the delivery a well-planned long term training programme which should take into consideration the different stages of development and maturation of each individual athlete. The LTAD programme should be based around the following principles;

- ***Focus on developing the appropriate movement or fitness qualities, throughout the different stages of the development or maturation process.***
- ***Avoidance of early specialization through just playing one sport.***
- ***Clear, precise and logical progressions throughout the training process in line with the maturation process.***
- ***Continuous monitoring and assessment of both general and athletic development through appropriate screening and testing methods.***
- ***Improve movement qualities and patterns before applying overload to young immature athletes.***
- ***Minimise / Reduce the risk of training and growth related injuries through effective monitoring and training load management.***
- ***Long term not short term, overall improvement of athletic capabilities.***

The LTAD journey and key influences so far:

LTAD & The Youth Physical Development Model-Baly et al 2002

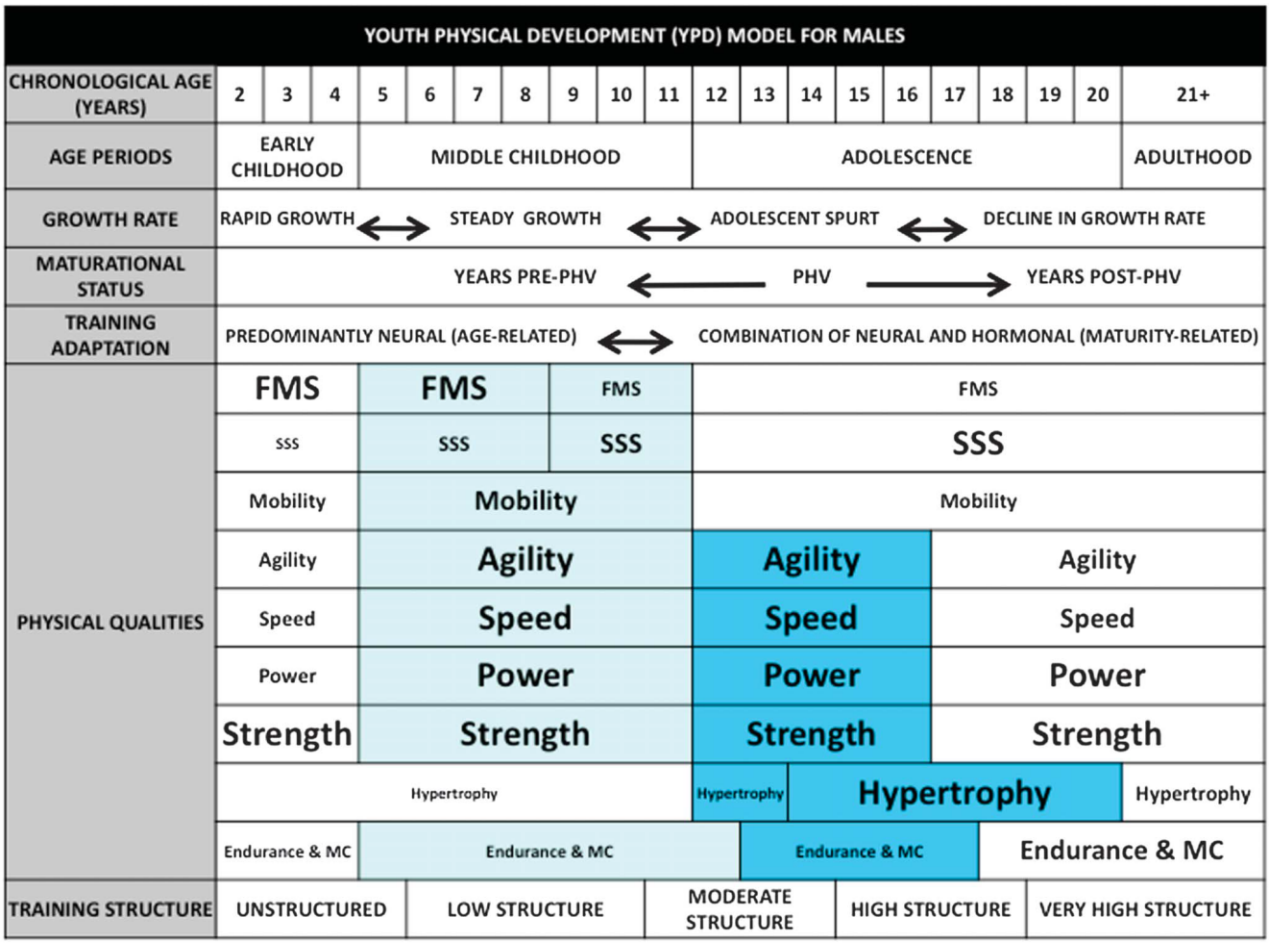


The Long Term Athletic Development (LTAD) Model was outlined in 2002. It was based on the premise that ***scaled down versions of adult athlete training programmes were and are not a good way of training young athletes. This is because of the wide variation in physical, cognitive and emotional development of athletes in this age group***. The LTAD model defines 4 and 6 generic stages of athletic development depending on the timing of sport specialisation (early or late respectively); suggesting that there are "windows" of optimal trainability for young athletes is the LTAD model and windows of optimal trainability are highlighted. Despite the notion of "optimal trainability windows" the authors state that all energy systems are always trainable, irrespective of physical development stage. With this in mind ***there has been renewed interest in a revised model in recent years***.

This prompted the work of ***Lloyd et al*** and the influence of the international consensus in 2014, as well as the NSCA and UKSCA and ASCA position statements. These eminent researchers, respected practitioners and bodies have presented their findings and models in recent years.

***The Youth Physical Development Model*-(Lloyd et al)** highlights that all aspects of fitness are trainable throughout youth and illustrates when and how best to train these over time.

The Youth Physical Development Model for Males: (Lloyd et al 2012)



Although this is clearly not a new concept the authors of the YPD model ***argue that it is more realistic as it acknowledges that many aspects of fitness are trainable throughout childhood.*** In summary the model suggests that during pre-pubescence, ***strength, fundamental movement skills (FMS), speed and agility should be the main focus of training.*** The authors also conclude that neural mechanisms will be the main adaptations that will occur to produce performance benefits during these years. ***Following puberty, and the hormonal growth spurt, sport specific skills, power and hypertrophy become more important.*** Training adaptations at this stage are attributed to increased androgenic hormone levels. Adding to the practical applicability of this model is the development ***of two separate models for females and males.*** The ***major difference between the two models is the time at which the hormonal or "adolescent" growth spurt occurs. This is earlier in females suggesting that training can be adapted to focus on sport specific skills, power and hypertrophy sooner.***

The Youth Physical Development Model for Females:

Models with which to guide the LTAD of young athletes are important to guide coaches in their general programme design. ***However, the non-linear nature of growth and development in children will always need to be catered for. Variables such as maturation status, training experience, technique and basic strength level must be taken into account. These variables need to be considered irrespective of the athlete's sex and chronological age***.

<table>
<tr><th colspan="20">YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR FEMALES</th></tr>
<tr><td>CHRONOLOGICAL AGE (YEARS)</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21+</td></tr>
<tr><td>AGE PERIODS</td><td colspan="3">EARLY CHILDHOOD</td><td colspan="5">MIDDLE CHILDHOOD</td><td colspan="8">ADOLESCENCE</td><td colspan="4">ADULTHOOD</td></tr>
<tr><td>GROWTH RATE</td><td colspan="20">RAPID GROWTH ↔ STEADY GROWTH ↔ ADOLESCENT SPURT ↔ DECLINE IN GROWTH RATE</td></tr>
<tr><td>MATURATIONAL STATUS</td><td colspan="20">YEARS PRE-PHV ← PHV → YEARS POST-PHV</td></tr>
<tr><td>TRAINING ADAPTATION</td><td colspan="20">PREDOMINANTLY NEURAL (AGE-RELATED) ↔ COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)</td></tr>
<tr><td rowspan="11">PHYSICAL QUALITIES</td><td colspan="3">FMS</td><td colspan="4">FMS</td><td>FMS</td><td colspan="11">FMS</td></tr>
<tr><td colspan="3">SSS</td><td colspan="4">SSS</td><td>SSS</td><td colspan="11">SSS</td></tr>
<tr><td colspan="3">Mobility</td><td colspan="6">Mobility</td><td colspan="11">Mobility</td></tr>
<tr><td colspan="3">Agility</td><td colspan="6">Agility</td><td colspan="5">Agility</td><td colspan="6">Agility</td></tr>
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<tr><td colspan="3">Power</td><td colspan="6">Power</td><td colspan="5">Power</td><td colspan="6">Power</td></tr>
<tr><td colspan="3">Strength</td><td colspan="6">Strength</td><td colspan="5">Strength</td><td colspan="6">Strength</td></tr>
<tr><td colspan="8">Hypertrophy</td><td>Hypertrophy</td><td colspan="7">Hypertrophy</td><td colspan="4">Hypertrophy</td></tr>
<tr><td colspan="3">Endurance & MC</td><td colspan="7">Endurance & MC</td><td colspan="7">Endurance & MC</td><td colspan="3">Endurance & MC</td></tr>
<tr><td colspan="3">UNSTRUCTURED</td><td colspan="5">LOW STRUCTURE</td><td colspan="4">MODERATE STRUCTURE</td><td colspan="4">HIGH STRUCTURE</td><td colspan="4">VERY HIGH STRUCTURE</td></tr>
</table>

Further Considerations for youth female athletes:

Comparative Strength Levels:

Clearly there are significant differences occurring for females hormonally during puberty with a high surge in oestrogen (far less testosterone than males) and subsequent natural biological increases in adipose tissue. In addition hip and knee joint angle changes and upper body strength deficits potentially emerge. During puberty for females, it is imperative that they are exposed to a great deal of total body weight physical literacy competencies with a real focus on glute and hamstring strength and control, as well as landing mechanics assessments being critical in relation to on-going programme design and prescription.

Stability and Range of Joint Motion:

Females can have significant joint capsule stability/laxity issues during and after puberty due to their higher potential (normally) for compliancy. Technical, strength, stability and dynamic agility movement weaknesses and subsequently higher injury risks are prevalent. (e.g. ACL rupture risks)

These factors need to be considered when assessing, programming and training female athletes.

Practical application of resistance training and weightlifting.

The table below details the current guidelines from the UKSCA for prescription of resistance training to young athletes. ***Chronological age of athletes is not specified in this table and may cause some confusion. However, as previously stated, there is consensus within the literature that when working in young populations' physiological age, training history and physical competency are details that should guide training, not chronological age.***

Suggested guidelines for youth –based resistance training prescription

Training Experience.	Beginner	Intermediate	Experienced	Advanced
Volume (Sets x Reps)	1-2 x 8-12	2-4 x 6-10	2-4 x 5-8	2-5 x 2-5
Exercises per Session	6-10	3-6	3-6	2-5
Intensity (%1RM)	BW or 60-70% 1RM	60-80%	70-85%	85-100%
Rep Velocity (Speed of Movement)	Moderate-Fast	Moderate-Fast	Fast-Maximal	Maximal
Rest Intervals (mins)	1	1-2	2-3	2-5
Frequency (Sessions per Week)	2-3	2-3	2-4	2-5
Recovery (hours between sessions)	72-48	72-48	48	48-24

In 2016 the National Strength and Conditioning Association (NSCA) published a reviewed position statement. This built on their previous publications spanning decades of practise and research into this

field of Strength and Conditioning. This latest outline from the NSCA offered "10 pillars for successful long term athletic development.

T***he tenth pillar suggests that the fundamental criterion for a successful LTAD programme is that qualified and well trained professionals are prescribing it. Should this be the case then the other factors, such as growth and load monitoring, individualisation of programming, injury prevention focus and engaging participants of all abilities will be catered for by the gold standard practise of qualified professionals.***

NSCA 10 Pillars 2016:

No.	Description
1.	Long-term athletic development pathways should accommodate for the highly individualized and non-linear nature of the growth and development of youth.
2.	Youth of all ages, abilities and aspirations should engage in long-term athletic development programs that promote both physical fitness and psychosocial wellbeing.
3.	All youth should be encouraged to enhance physical fitness from early childhood, with a primary focus on motor skill and muscular strength development.
4.	Long-term athletic development pathways should encourage an early sampling approach for youth that promotes and enhances a broad range of motor skills.
5.	Health and wellbeing of the child should always be the central tenet of long-term athletic development programs.
6.	Youth should participate in physical conditioning that helps reduce the risk of injury to ensure their on-going participation in long-term athletic development programs.
7.	Long-term athletic development programs should provide all youth with a range of training modes to enhance both health- and skill-related components of fitness.
8.	Practitioners should use relevant monitoring and assessment tools as part of a long-term athletic development strategy.
9.	Practitioners working with youth should systematically progress and individualize training programs for successful long-term athletic development.
10.	Qualified professionals and sound pedagogical approaches are fundamental to the success of long-term athletic development programs.

Influences in the field of paediatric strength and conditioning?

At the YSCA we recognise that there are many outstanding paediatric strength and conditioning practitioners and researchers who have shaped our views and the practice of good youth coaches around the world. There is not space to identify everyone but below are four key people who have significantly positively shaped the quality and safety of youth strength training and whose work is well worth taking the time to read and learn about:

Kelvin Giles MA, Cert Ed

A former UK National and Olympic Track & Field Coach, Kelvin spent 30 years in Australia's high performance sport environment. He was Head T&F Coach at the Australian Institute of Sport in Canberra and Head of the Athletic Development department at the Queensland Academy of Sport in Brisbane. He spent 6 years at the helm of the Brisbane Broncos Rugby League team as Director of Performance and also led the Australian Rugby Union's Elite Player Development section. He is a coach to 14 Olympic and World Championship athletes over a 40 year career. He is currently CEO of Movement Dynamics UK Ltd and currently consults across a range of National Governing Bodies and Federations and is the author of the ***Physical Competence Assessment resources.***

Regarded as a world leader in the field of paediatric strength and conditioning and athletic development we are proud to welcome Kelvin Giles to the faculty at the YSCA. Kelvin is the founder of Movement Dynamics, an athletic development consultancy specializing in the wellness and health of young people all over the world.

Kelvin's application of 'physical competency' and passionate belief in young athletes 'earning the right to progress' through thoughtfully structured and progressed (or regressed) movement and strength programmes has shaped the best practice of youth training around the world.

Dr Avery Faigenbaum,

Dr. Avery Faigenbaum is a Full Professor in the Department of Health and Exercise Science. He joined The College of New Jersey in 2004 and teaches a range of courses covering health promotion, exercise prescription, and clinical exercise physiology. His research interests focus on pediatric exercise science, resistance exercise, and preventive medicine. He incorporates years of experience as a pediatric exercise scientist into his classes and strives to "bridge the gap" between the laboratory and the playing field. His pedagogical approach which involves reflection and evaluation challenges his students to put theory into practice and to think about what they are doing, why they are doing it, and how it can be a meaningful and long-lasting experience for the students and patients they will work with in the future.

His prospective research involves exercise interventions in public schools and youth centers to understand changes in health, fitness and athleticism in children and adolescents. As an active researcher and practitioner, he has co-authored over 200 peer-reviewed publications, 40 book chapters and 10 books including Youth Strength Training, Strength and Power for Young Athletes, and Progressive Plyometrics for Kids. Dr. Faigenbaum has been lead or co-author on several position statement papers on youth resistance training.

At the YSCA we recognise and highlight the significantly important volume of ground breaking applied research Dr Faigenbaum has completed relating to Pediatric strength training.

Dr Gregory D Myer

Gregory D. Myer, PhD, FACSM, CSCS*D is the Director of Research and The Human Performance Laboratory for the Division of Sports Medicine at Cincinnati Children's Hospital Medical Center and maintains his primary faculty appointment in the departments of Pediatrics and Orthopaedic Surgery in the College of Medicine at the University of Cincinnati.

Over the past decade, Dr. Myer has published over 240 articles in peer reviewed medical journals and has published books and several book chapters related to his research on the biomechanics of knee injury, sports performance and knee injury prevention training. Dr. Myer has received numerous awards for his excellence in sports medicine research.

We would recommend at the YSCA that reading about Dr Myer's work into ACL injury prevention and recently his fascinating work into concussion prevention in young people, playing sport is of significant value for youth strength and conditioning specialists

Dr Stuart M. Mcgill

Dr. Stuart M. McGill is a professor emeritus, University of Waterloo, where he was a professor for 32 years. His laboratory and experimental research clinic investigated issues related to the causal mechanisms of back pain, how to rehabilitate back-pained people and enhance both injury resilience and performance. This produced over 240 peer-reviewed scientific journal papers, several textbooks, and many international awards. He mentored over 40 graduate students during this scientific journey.

During this time, he taught thousands of clinicians and practitioners in professional development and continuing education courses around the world.

He continues as the Chief Scientific Officer for Backfitpro Inc. His advice is often sought by governments, corporations, legal experts, medical groups and elite athletes and teams from around the world. Difficult back cases are regularly referred to him for consultation

At the YSCA we recognise the critical importance of preserving back health in young people. Dr Mcgill's work in the prevention of back injury applied research and his subsequent world leading books are a must for any youth specialist practitioner to read and apply in their coaching practice

What intensity should young people train at? How does this evolve over time?

Training Volume and Intensity:

Training volume and intensity are important variables that can be manipulated during training sessions and or cycles based on training goals. Training intensity refers to the amount of resistance used for an exercise, as a percentage of 1RM. Training volume refers to the total amount of work performed during a training session. A general rule of thumb is that these variables will have an inverse relationship with one another.

However, in young athletes measuring 1RM (absolute or predicted) may be unnecessary and unsafe; therefor higher numbers of repetitions may be prescribed with a low external weight or even the

athlete working against their bodyweight. Although both variables are closely linked, it is suggested that intensity of training is more important when coaching young athletes. This is due to the injury risk of exposing children or adolescents to excessive external loads. Despite this, it should not be forgotten that excessive volume can lead to chronic injury or the development of overtraining.

Once again the issue is guided by the individual's competency, strength and fitness level. Neither exercise volume nor intensity should be progressed at the expense of technical ability. ***Youth coaches should be aware that with naturally changing limb lengths, the technical competency of young athletes may be transient; therefore, training programmes should be adjusted to allow for these periods.***

Rest Intervals During Training:

Rest intervals of around 60 seconds should be ample for inexperienced children performing a moderate intensity training session. As athletes mature through adolescence rest intervals can be extended (minutes) depending on training goals, intensity and volume. This is especially pertinent as the athlete's training age increases and complex, multi-joint strength and power exercises are added into their programme.

Repetition Velocity:

It is widely accepted that the velocity at which exercises are performed can have a profound effect on the physiological adaptation to the exercise stimulus. ***Competency and technique are again a factor that will govern the velocity at which exercises are performed by young athletes***. ***Athletes with limited experience should perform exercises at a moderate velocity and focus on learning movements proficiently.*** Whereas an adolescent athlete with a number of years training history may be proficient enough to be exposed to larger movement velocities when training.

Training Frequency:

Training frequency refers to the number of training sessions that are performed during the week. The recommended resistance training frequency in a LTAD programme is 2-3 sessions per week on non-consecutive days. If training frequency exceeds this amount it is suggested that variables, outlined above, should be varied to maintain interest of the athletes and exercise technique should be a constant focus.

Programme Variation:

Periodisation is the process of systematically varying a training programme over time; challenging the body to adapt to varying demands. Despite additional research being needed; it is logical to suggest that children and adolescents taking part in well designed, periodised resistance training programmes which continue to develop their health and fitness may be more likely to adhere to their training programmes.

A comment on 'Power lifting' and a word of caution:

Power lifting can be a great adult sport and as an association we are not in any way against it and those people who engage in it. It is as we know a sport where maximal Deadlift, Back Squat and Bench Press 1

RM's are performed to achieve an overall weight total. All three of these lifts/movements are integral parts of a youth strength training programme. However, all need to be taught with the strictest standards of technique and form, spotted and supervised as they are demanding physiologically and all carry with them inherent risks to a young athlete.

Injury rates in youth power lifting are concerning and high: 13.8 per 1000 hours. This may well be due to the simplicity of the lifts when compared with the Weightlifting equivalent lifts; Clean and Jerk and Snatch plus as ***this can lead to unsupervised maximal lifting (by young people)occurring which we categorically do not recommend or endorse at the YSCA.***

Thus, whilst we endorse appropriate prescription of the three key lifts (Back Squat, Bench Press, Barbell Deadlift) within a well-structured and loaded training week. ***We do not endorse maximal power lifting type training or pushing for absolute 1RM testing in the Deadlift, Back Squat and Bench Press.***

Our stance only has some flexibility in it in the instance of youth coaches working with older adolescent athletes approaching 18 who are on the verge of or involved in senior professional or international representation where maximal testing in some of the lifts may be required or desired. This is only appropriate if the athlete is highly experienced and used to lifting 'heavy near maximal loads' in training.

YSCA Applied age/stage range related practice:

As we have already identified it is important to note that when trying to put any 'stage' or 'age' related guidance together one will always hit the problem that every child has a unique mental, physical and skill

growth experience. Age related guidance can be problematic as clearly ***the individual needs of children completing strength and conditioning need to be the focus of any programme.***

What age should young people start 'training'?

What weight? When? How heavy?

Level 1: Age 6-9

Growth & Maturation	General Training Suggestions
The child is more skilful in gross movements involving large muscle groups than in precise coordinated movements involving the interaction of many smaller muscles.	**General basic skill should be developed during this phase.**
The size of the heart is increasing in relation to the rest of the body. The cardiovascular system is still developing.	**Short duration anaerobic activities (alactic) must be planned; Endurance must be developed through play and games.**
Ligamentous structures are becoming stronger; Both ends of the long bones are still cartilaginous and continue to ossify.	**Careful progression in hopping, jumping, own bodyweight and medicine ball exercises. Volumes and intensity kept low.**
Basic motor patterns become more refined towards the end of this stage. The balance mechanism of the inner ear gradually matures.	**Specific activities and games should emphasise coordination. Kinaesthetic sense emphasised in gymnastics, diving, athletics field events.**
During this stage girls develop coordination skills faster than boys but generally there is little difference between the two sexes.	**Training and playing together should be emphasised at this stage.**

Key general physical/athletic considerations 6-9 Year olds:

- Hand and foot speed can be developed especially well by boys and girls during this stage.
- This is a great age for children to take part in a wide range of sports. They should be encouraged to take part in as many different types of activities as possible.

- It is important that all children master fundamental movement skills before sport specific skills are introduced.
- Strength, endurance and flexibility need to be developed, but through games and fun activities rather than necessarily just a structured training regimen.

Resistance/strength training guidance:

- Modification, regression and then progression of physical literacy spectrum of movements. (Squat, push, pull, lunge, brace, rotate, hip hinge, single leg) Focus on Body weight and rubber band resistance loadings.

Level 2: Age 10-15

Growth & Maturation	Training suggestions
Significant proportional changes occur in bone, muscle and fat tissue.	**Monitor training carefully and individualise the content of training to ensure adaptation whilst minimising the risk of overuse injuries such as fractures and growth plate injuries.**
Girls begin their growth spurt between 11-14 years, boys between 12-15 years. Girls achieve a maximum rate of grow that an average age of 11, boys at an average of 14 years.	**Early in this phase girls maybe faster and stronger than boys; Later in the phase boys begin to get the upper hand in these qualities. Chronological age may not be the most appropriate way to group young athletes.**
Smaller muscle groups are becoming more developed. Speed, agility and coordination are still improving rapidly at this stage.	**With the improvement of fine motor movement all basic technical skills can be mastered. Athletes must learn how to train during this period including physical, technical, tactical and ancillary capacities.**
A significant increase in red blood cells occurs during this stage, especially in boys due testosterone. The oxygen transport system is still developing and aerobic endurance continues to increase.	**The increase in body mass requires more structured aerobic training. Only short duration of anaerobic activities are recommended.**

Key general athletic/physical considerations 10-15 years olds

- A greater emphasis on more specific skills, although should still be fun and enjoyable. Also team sport position specific skills are introduced without specialisation.
- There should be a greater emphasis on strength and some endurance training during this stage, especially after PHV has been achieved.
- Emphasis should be on learning how to train, on the process, not on the outcome.

- A sound screening of the athlete can now take place to ensure accuracy in exercise selection.
- During training competitive situations in the form of practice matches or competitive games and drills should be included.
- ***A key reason why many athletes hit a plateau during later stages of their development has to do with too much competition and not enough training during this stage.***

Resistance/strength training guidance:

- Assessing movement patterns (Movement assessment and YAPS Testing) should guide an individualised programme and exercise prescription.
- This is the most significant and varied growth period from child to child as ongoing adjustments, progressions and critically regressions are essential during its stage.
- 'Cumulative Load' understanding needs to inform weekly training structure
- PHV and PW measurements ned to be recorded and regularly to inform prescription and loading decisions
- An awareness of the effects of puberty on females and males should guide and inform training design.
- Be careful with volume and loadings of back squat and BB Deadlift loading prescriptions with males going through PHV

Level 3: Age 15-18

Growth & Maturation	Training suggestions

The circulatory and respiratory systems reach maturity. These systems are generally able to deliver maximum output.	**Aerobic and anaerobic systems can be trained for maximum output. Full sports specific energy system training can be implemented.**
Muscles have grown to their mature size but muscular strength continues to increase reaching its peak in the late twenties.	**Strength training can be maximised to improve overall strength development. Neuromuscular training should be optimised during this stage.**
Skeletal maturation continues in males and females. Connective tissues are still strengthening.	**Progressive overload in training should be continued.**
By age 17 girls have generally reached adult proportions whereas boys may reach these proportions several years later.	**Aerobic training for girls should be optimised. Coaches must be aware of how to deal with weight gain and the personal and social effects. Athletes must learn how to compete under differing** **Circumstances.**

Key general athletic/physical considerations 15-18 years olds

- Have the athletes perform their skills under a variety of competitive conditions during training.
- Continue to tailor and refine individual training programmes, recovery strategies, psychological preparation, and technical development.
- Emphasize individual preparation that addresses each athlete's individual strengths, weaknesses and individualised physical requirements
- Coaches should consistently use Periodisation plans as the optimal framework of preparation

Resistance/strength training guidance:

- Cumulative load management becomes critical at this stage particularly for multi-sport young athletes who train and play for multiple clubs/school/representative levels
- Sets and reps can be adapted and made more individually and periodisation specific. (6-15 RM-utilisation of % calculations without the need for absolute 1RM testing)

- Split and more ‘undulating’ programmes can be introduced with tapering around competitions a consideration
- Hypertrophy training can be more regularly prescribed
- Female hamstring strength, glute activation and landing mechanics work must be continued, progressed and monitored

Level 4: Age 18+ ‘Young Adults’

Growth & Maturation	Training Suggestions
Both males and females skeletal system should be fully developed.	**Athlete can handle greater increases in training volume especially in weight bearing activities.**
Both aerobic & anaerobic energy systems fully developed.	**Supplementary anaerobic conditioning can be integrated (Speed End. & RSA)**
Skeletal muscle mass should be at its peak due to increase hormone production especially testosterone in males.	**Athlete can manage greater volume and loads in regards to resistance / strength training.**
Should be physically and emotionally mature to handle the pressure of competition.	**Training should be sports specific and replicate both the physical and emotional demands of the sport**

Key athletic/physical considerations during ‘young adulthood’

- Towards competition specific training must be tempered with a commitment towards long term development.

- During this stage training approaches consistently high intensity and specificity all year round.
- Strength is developed through the more advanced external loading strategies (undulating) and more complex exercises.
- Training the lactic energy system should be maintained.
- More emphasis on sports specific and individual specific work.
- Simulation of all competition conditions including competition specific training can slowly be introduced over several years and tapering techniques become more advanced.

Resistance/strength training guidance:

- Despite the 'arrival of adult-hood' programme should still be carefully evolved as male 'late developers' may still be in the previous stage physiologically.
- More advanced lifting, loadings, periodisation, nutrition strategies, volumes and intensities should be being trained or have been 'prepared for'
- Effective 'handovers' are critical at this stage. Young adult athletes will be moving into senior environments and or university situations. Previous training and injury history needs to be passed on to 'new coaches' and 'environments'

How should progressions and regression - 'Earning the right to progress' happen?

'Resistance training prescription should be based according to training age, motor skill competency, technical proficiency and existing strength levels. Qualified professionals should also consider the biological age and psycho social maturity of the child or adolescent. (Lloyd et al.2014 p8)

Exercise Choice and Order:

Choice of exercise should promote muscle balance and be appropriate for a child's body size, fitness level and exercise technique. Logic and literature suggest that starting with simple exercises and progressing programmes to include more advanced multi-joint exercises as confidence and competence develop is the most appropriate method of programme design for children and adolescents. During childhood and the ***"beginner"*** stage of resistance training exercises should be focussed on developing movement competency and ***physical literacy.***

'Most young athletes will perform whole body training sessions multiple times during a week. In this type of training session it is recommended exercises focussing on large muscle groups should be performed first, followed by exercises focussed on smaller muscle groups. This is also recommended for exercises focussing on multiple joints, being performed, before single joint exercises.'

Once a young athlete can demonstrate competency, training prescription should and can be progressed to include more advanced exercises that challenge the child in terms of coordination and that may require a greater level of force generation.

Here is an example entry level programme:

Level 1 Beginner Programme: (Taken from England Golf work by Brendan Chaplin)

- To be completed 2-3 times per week

GO THROUGH DYNAMIC WARM-UP BEFORE EACH SESSION

1. **Hands behind head Squats 3 x 15**
    a. Stand with your feet wider than your hips, chest out, toes pointed out slightly
    b. Push your hips back and bend your knees untill your hips are in line or slightly below your knees
    c. Keep your chest out

2. **Vertical Jumps with soft landings 3 x 5**
    a. Stand with hands on hips chest out
    b. Jump upwards and land in a squat position (same as exercise 1)
    c. Landing should be quiet and solid

3. **Hop and Holds (Forward) 3 x 6 each**
    a. Start by standing on one leg, chest out knees bent
    b. Hop forwards and hold the landing
    c. Landing should be quiet and with control through the knee

4. **Split Squats 3 x 12 each leg**
    a. Start in a lunge position, chest out, hands behind your head
    b. Slowly lower your back knee to the floor, lightly touch and push back up with the weight through your front heel
    c. Set your stance long to avoid the front knee moving over the toe

5. **Plank Circuit (Front/Left/Right) 3 x 20s each**
    a. Position yourself on the floor on your elbows and toes
    b. Hold your body in a straight, solid position for the duration

6. **Single Leg Holds with Dip 3 x 10 each**
    a. Balance on one leg with your arms out to your sides to stabilise
    b. Move up and down on one leg slowly and control your knee

7. **Aleknas 3 x 12**
    a. Lie on the floor with your legs straight and arms straight
    b. Bring your knees to your chest and arms over your shins at the same time
    c. Extend your legs and arms back to the start position but DON'T let your feet or hands touch the floor once you have started

Over time this programme will progress:

Level 3 Beginner Programme:

- To be completed 2-3 times per week

Dynamic Warm-Up: Walk-Outs, Floor Slides, Push-Up Plus, Side Squats, Reverse Lunge to Knee Raise ALL DONE FOR 12 REPS EACH

1. **Hands behind head Squats with 3s hold in bottom position x 12 reps**
    a. Stand with your feet wider than your hips, chest out, toes pointed out slightly
    b. Push your hips back and bend your knees until your hips are in line or slightly below your knees
    c. Keep your chest out

2. **Push-Ups with Shoulder Touch**
    a. Position yourself on the floor on your hands and feet
    b. Lower yourself to the floor keeping elbows in at all times, touch your shoulder with opposite hand at the top of the push-up

3. **Single Leg Sit Downs**
    a. Start balancing on one leg and in a position to squat down to a chair.
    b. Lower yourself down to the bench and touch your hips before standing back up on one leg.
    c. If you cannot reach the position on one leg go 2 down 1 leg up, or 1 down 2 legs up and alternate each leg.
    d. Keep your chest out at all times.

4. **Plank to High Plank**
    a. Start in a push-up position with your feet wider than your hips
    b. Lower yourself to the elbow plank position with both hands
    c. Repeat on other side
    d. Keep your hips stable at all times

5. **Forward/Reverse/Lateral Lunges sequence**
    a. Lunge forward with left foot, then straight into reverse lunge, then straight into lateral lunge. Repeat on both sides.

6. **Alekna Holds**
    a. Lie on the floor with your legs straight and arms straight
    b. Hold yourself in this position for 40 seconds. If you need to bring your legs higher that is fine.
    c. Do not allow the back to do the work. Bend knees or lift legs higher to avoid this.

There are many ways to progress a young person's programme carefully. An increase in sets and reps volume and manipulation of recovery/rest periods is an initial adjustment. Advances in movement pattern complexity, loadings, amplitude and speed are all progressions. At the core of all decision making must be that excellence is achieved at each level of progression, that qualities will not be endured before they are first mastered for one repetition, that in essence young people '*earn the right to progress safely*'

Conclusion:

There is consensus in recent literature and applied paediatric strength practice ***that appropriately designed and monitored training programmes are safe and can be successfully applied to young athletes.*** Consensus also suggests that a training programme should be well-balanced and must include agility and movement training, resistance training, balance and proprioceptive training and conditioning for cardiovascular fitness. Throughout this is an overriding agreement that practitioners in the paediatric training environment should be well-trained and up to date with current methodologies and ideologies. ***They should also aim to design programmes that excite participants to want to participate in an engaging training environment with a focus on a health-orientated approach.*** This may then enable them to a life-long approach to health and physical activity, irrespective of performance level.

YSCA Key guidance:

The YSCA identify that the development of 'Physical Literacy' and dynamic movement efficiency including resistance based strength training is a critical foundation of young people's **physical and mental growth journey**. Underpinning effective and efficient movement patterns, support young people in their physical lives enabling them to participate in activities and sports far more safely.

The YSCA recognise that a child's movement journey is individual and coaches working with all children should be expert in creating an individualised, safe, load, progression and regression appropriate setting for children and adolescents to learn and progress within. Every child's movement progression journey should be 'Exciting, Engaging and Enabling'.

The YSCA 8 Key Criteria for 'SAS' ('Smart, Appropriate, Safe') Paediatric Strength and Conditioning practice:

1. Strength/resistance training if supervised and coached appropriately is safe for young people to participate in.
2. Strength/resistance training if completed safely and effectively with young people will reduce the occurrence of sporting injuries through the development of the musculo-skeletal system.
3. To begin training young people need to have the emotional maturity and appropriate behaviour levels to understand what they are doing and accept instructions to be capable of training safely.

4. A youth strength training programme needs to be expertly coached and supervised by an adult at all times.
5. The programme implemented needs to be individualised, progressive and physical literacy based with young people *'earning the right to progress'*
6. The modalities employed need to be functional, movement based that build multi- directional strength and body awareness.
7. Technical competence and mastery of movement should be the primary goal rather than achieving the highest possible loadings and volumes in a youth strength training programme.
8. Young people should experience an 'Exciting, Engaging and Enabling' training environment.

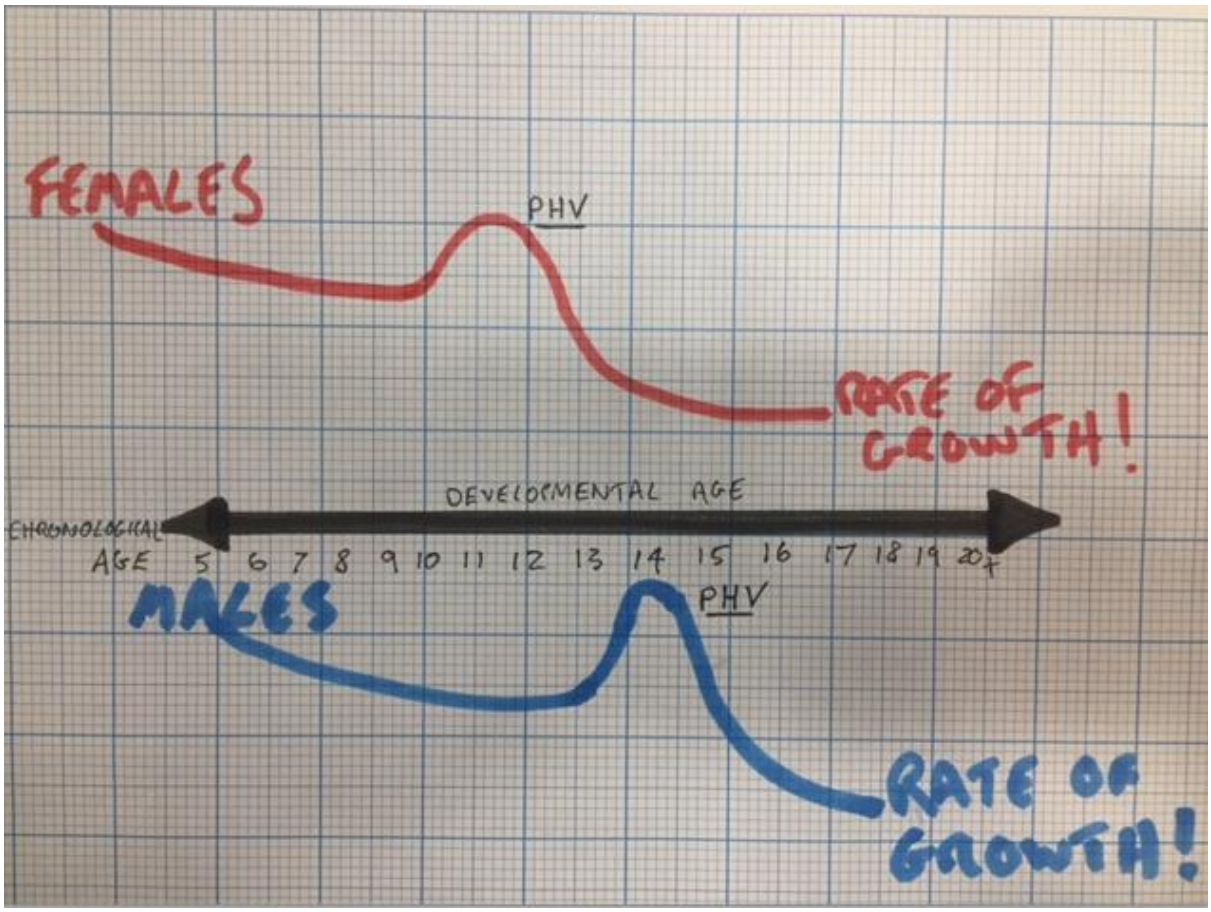
Youth growth and cumulative load considerations

Peak Height velocity

Peak, height, velocity (PHV) PHV is the time in a child's life in which they experience the most rapid height growth and tends to coincide with sexual maturation and rapid changes in bone structure. In girls, this typically happens at around twelve years of age, and in boys at age fourteen, although it can occur more than a year before or after these estimates.

PHV is calculated by regularly taking height (sitting & standing) and weight measurements and then using a regression equation to predict when an athlete will reach PHV. This information can be important to identify when young athletes may be more suited for varied training components.

An Early idea of LTAD in relation to PHV



It is apparent from this predicted model above ***(Based on earlier LTAD thinking (Baly et al)*** that females normally reach PHV before males. Before, during, and after PHV there appears to be certain periods in time in which young athletes are more sensitive to particular types of training (e.g. strength, speed, and hypertrophy).

These time periods have often been referred to as ***"windows of opportunity" in initial LTAD models*** of thinking which also imply that these opportunities can be 'missed' if the appropriate training stimulus is not applied and therefore athletes may arguably miss a vital opportunity to maximise their athletic potential. ***Recent thinking has been a little less focussed on this idea of specific training modality 'windows of opportunity' timings and has questioned 'when they are' and 'what' should be emphasised in training*** (refer to Youth Movement Journey review section of the manual) but there is no doubt that a young person's athletic journey whilst individual has some key time periods where an absence of well-designed and planned physical training will lead to a deficit in adult life.

It is suggested that if the ***physical movement journey*** is miss-managed or opportunities are missed, then that a young person may experience an '**athletic ability ceiling'** as an adult, which may well be lower than if they were to train throughout that time. In addition if young people are beginning their Strength and Conditioning experience in their mid to late teenage years as a coach one can definitely feel like one is playing ***'catch up'*** and often at the very least having to make up for lost training time when in an ideal setting they would be adding more loaded, advanced and enhanced progressions across all fitness components.

It is believed that young people who exploit this overall 'earlier training opportunity' have a higher ceiling for their athletic potential than those who do not. This has led to the development of the term ***"periods of accelerated adaptation",*** which are simply time periods of opportunity for young athletes' to make greater improvements in athleticism than otherwise may be possible.

These periods of accelerated adaptation have many implications for training programme design, including: training content, intensity, volume, frequency, Periodisation and indeed coaching approach.

It is believed that by calculating a child's ***onset of PHV*** it can enable the coaches to tailor the training programme in relation to the athlete's ***biological age as opposed to their chronological age*** in order to develop a better physically tailored and more effective training programme. It is suggested that preadolescents benefit more from training methods which require higher levels of neural activation, whereas adolescents responded better to training types which target both neural and structural development. It is also well known that adolescents respond more favourably to hypertrophy training

than preadolescents due to the higher concentrations of certain hormones such as ***testosterone and growth hormone***. Also, during the onset of the adolescent growth spurt, boys typically experience greater maturational improvements in all aspect of fitness than girls (e.g. strength and power), except for flexibility.

Key Messages

- ***Children and adolescents are not little or 'mini' adults and therefore should not be trained like them.***
- ***Closely monitor for rapid changes in growth and maturation (PHV-Peak Height Velocity).***
- ***Avoid early specialization.***
- ***Develop good general and all round movement competencies.-'Physical Literacy'***
- ***Understand the effect PHV and hormonal changes will have during phases of growth and development in young people in relation to the training modality prescriptions chosen.***
- ***Ensure that training is fun and enjoyable with specific aims and objectives.(Excite, Engage, Enable)***
- ***Have a well-planned and designed approach for each development stage.***
- ***Refer to the YSCA PHV calculation tool to aid your management of this key area***

Cumulative Load:

The word 'load' is used all the time in relation to training. It is a generic and specific term which depicts the volume, intensity and resistance which a young athlete experiences in training. It can be used in a very specific context e.g. the player completed four sets (4 x 10) of Back Squat at a load of 85kg or the training unit load for the week was 46 units. Or it is often used in more descriptive terms: '***the athlete has had a heavy load in training this week.***'

Essentially ***cumulative 'load'*** *in a training context refers to the volume of external stress the body is being exposed to during the diverse training week or cycle over a period of time*. When coaches and Strength and Conditioning Coaches work with young athletes it is imperative that they recognise what the ***cumulative load*** is in each day, week and cycle.

Young people get injured or ill, or stay out of condition when the cumulative load is not understood or neglected. With young people there are a range of key people not least their parents or guardians who have input in to their development. Injuries occur when these people do not effectively communicate and plan the child's life and training together. If managed poorly this can in its worst instance lead to the young person sustaining an ***overtraining*** based injury.

It can be a straight forward process: A strength and conditioning coach can be a central figure coordinating when all fitness training sessions should fit around the sports and lifestyle schedule and if he or she has a positive relationship with the team around the young person then he or she may be able to influence positively the loading and scheduling of the whole week.

Measuring Cumulative Load:

Cumulative load needs to be managed and measured carefully particularly with a young growing person. All volumes of training should take in to consideration and ***Peak Height Velocity*** growth data should be accurately recorded, monitored and evaluated on an ongoing basis.

At the elite sporting level the effect of cumulative load can be measured using advanced technology. These measure the athlete's physiological responses to training, the quality of their sleep and stress responses.

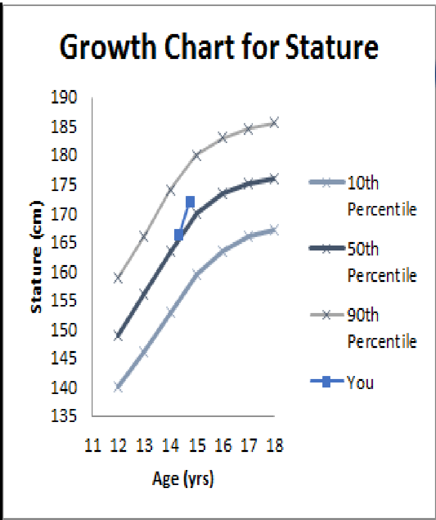
One does not require expensive monitoring tools if as a coach we can gain accurate data information from young athletes.

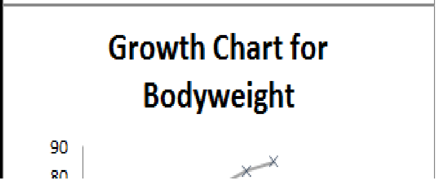
Male and Female PHV Growth and Body Mass Measurement tool:

See below a screen shot of the tool for calculating an individual child's growth in

relation to Peak Height Velocity (PHV). You will have received the tool pre-course with your Theory manual. The tool identifies the rate of growth (to within a 6-month margin of error) how far away, completely through, or currently experiencing PHV a young person is. The tool is designed to be used each time with the same individual. The graphs track their height and mass growth data. You will have the effective use of these tools explained to you during the course but below is key guidance as a reminder:

Age	Body Mass	Height	Seated Height	Leg Length	SH & LL Interaction	Age & LL Interaction	Age & SH Interaction	Leg by Height Ratio	Estimated time from PHV (yrs)
14.33	62.00	166.30	83.00	83.30	6913.90	1193.69	1189.39	50.09	0.04
14.75	64.00	172.00	85.20	86.80	7395.36	1280.30	1256.70	50.47	0.44
				0.00	0.00	0.00	0.00	-	-
				0.00	0.00	0.00	0.00	-	-
				0.00	0.00	0.00	0.00	-	-
				0.00	0.00	0.00	0.00	-	-
				0.00	0.00	0.00	0.00	-	-
				0.00	0.00	0.00	0.00	-	-
				0.00	0.00	0.00	0.00	-	-
				0.00	0.00	0.00	0.00	-	-
				0.00	0.00	0.00	0.00	-	-
				0.00	0.00	0.00	0.00	-	-





*This Chart is to record one person's data over a period of time

Example Age conversion

13 years 6 months - 13.5
13 years 4 months-13.33
13 years 9 months-13.75

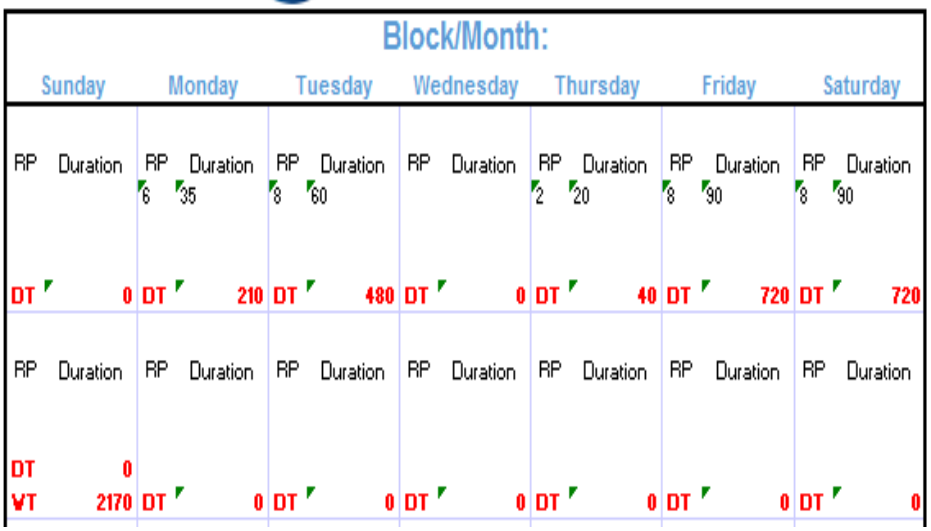
Guidance:

- Fill in the information on the left hand side column's for the Age, Body mass, Height (standing) and Seated height. The other columns will then immediately calculate.
- Important to note that for the calculations to work age has to be recorded as the conversion table suggests e.g. a young person who is 13 and 6 months actually needs to be recorded as 13.5 as a decimal for calculations to work.
- Minus value (final column) denotes years until estimated PHV. Positive values denote an athlete who has passed PHV. A zero value suggests estimated PHV is imminent. This calculation is not an exact science and can have an error of +/- 6 months.

Weekly Cumulative Load training measurement tool:

This screen shot shows the weekly Cumulative Load measurement tool. A

simple tool which enables you to measure the training load in units by working closely with your young athletes:



Block/Month:						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
RP Duration	RP Duration	RP Duration	RP Duration	RP Duration	RP Duration	RP Duration
	6 35	8 60		2 20	8 90	8 90
DT 0	DT 210	DT 480	DT 0	DT 40	DT 720	DT 720
RP Duration	RP Duration	RP Duration	RP Duration	RP Duration	RP Duration	RP Duration
DT 0						
WT 2170	DT 0	DT 0	DT 0	DT 0	DT 0	DT 0

RP:Perceived Rate of Exertion
DT: Daily Training load
WT: Weekly Training Load

Guidance:

- Complete the tool each day with the young athlete. As the diagram demonstrates you fill in the ***RP cell*** and the ***Duration cell.***
- This in turn prompts the tool to calculate the Daily training load by multiplying the RP (expressed as a subjective measure each time by the athlete after each session) by the duration figure recorded by you.
- This will result in the Daily training (DT) load to be calculated and after 7 days the Weekly Training Load.

- After completing this tool for 6 weeks you will be able to develop a very accurate understanding of what ***light, medium and heavily*** **loaded** training weeks look like for your young person. You will also have a very good real time measure of the young person's

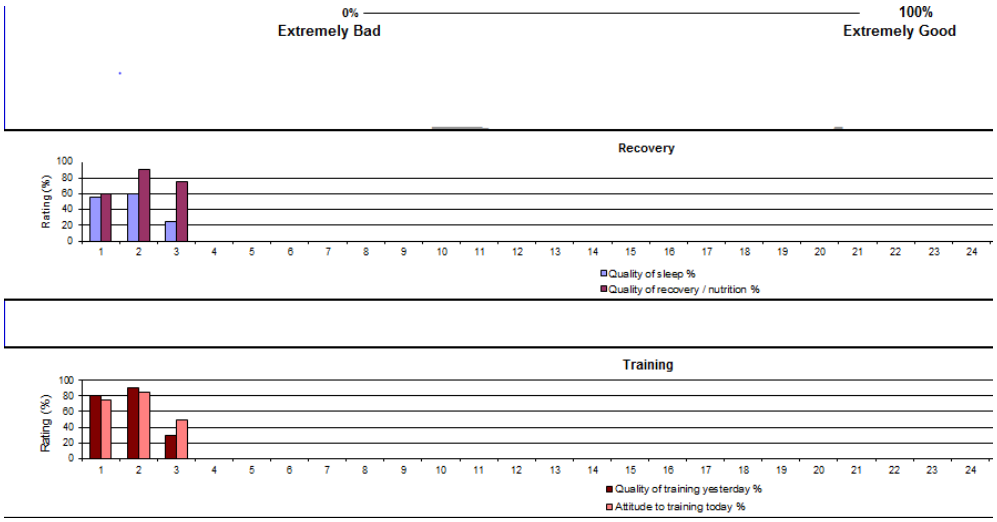
daily perceived levels of exertion and how they are responding to the training experience with you. This can then inform programming and rest and recovery decisions.

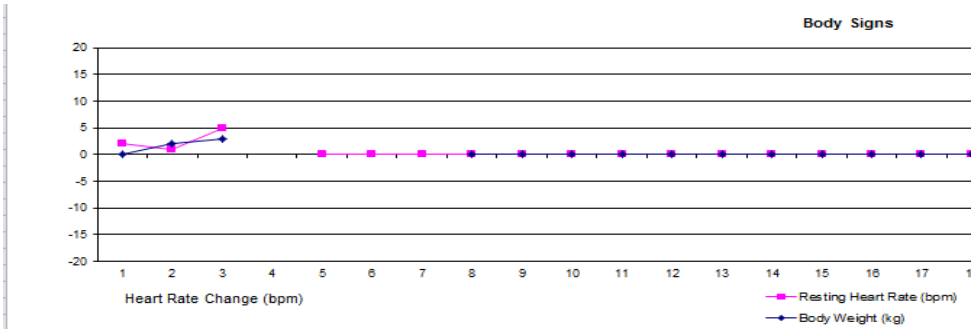
YSCA Welfare Monitoring tool:

Below is a screen shot of the Welfare Monitoring tool. It is subjective and objective, but it enables you to engage with your adolescent athletes and help them understand how they feel about the training process and get a measure of their recovery status and physiological responses:

Name: Ben Haining **Month** January

Subjective	Quality of sleep %	55	60	25									
	Quality of training yesterday %	80	90	30									
	Quality of recovery / nutrition %	60	90	75									
	Attitude to training today %	75	85	50									
Objective	Body Weight (kg)	95.00	95.40	94.90									
	BW Change (kg)	0	0.4	0.6									
	Resting Heart Rate (bpm)	58	59	64									
	HR Change (bpm)	2	1	5									
	Date	1	2	3	4	5	6	7	8	9	10	11	12





Guidance:

- The young person fills out the subjective and objective data daily. This then immediately charts graphs in relation to their mental physical status and actual physiological responses to training.
- The more days completed the more accurate becomes the picture relating to how well the young person is ***training, responding to training and recovering***

Another simple measurement tool is to record *vertical jump measurements* at the beginning and end of a training week. This offers good information relating to each child's adaptation status to the volume of training being experienced and weather they are adapting effectively to the periodised training plan. Heart rate measurements and training logs which record athlete perceived levels of exertion and fatigue are also good measures from a psychological perspective.

It is as shown above, very straight forward to measure the intensity of a training week by recording how many ***training units*** a player is completing and or recording the entire programme training volume in minutes. Another further measure would be to multiply each unit by a perceived exertion rate e.g. speed sessions 40 minutes x 10 (level of exertion out of 10 scale) = 400 units.

By going through these measurement processes coaches can keep an accurate handle on the volume of training and can also plan 'heavy', 'medium' and 'light' training weeks in to the mesocycles.

To conclude managing and measuring the cumulative load of all areas of young people's training is critical in optimising training adaptation, avoiding overtraining injuries and illness and maximising athlete well-being.

Young Athlete Performance Scale (YAPS)

The Reasons for 'Testing' young athletes:

1. ***Testing highlights the current physical level of a young person*** **across a range of parameters. Effective interpretation of these results enables a training programme to be devised which will be tailored to specifically improve that young athlete in the future.**
2. ***To evaluate progress or regression.***
3. ***To evaluate the effectiveness of a training programme*****. Is it working?**
4. ***To aid motivation and support current and future goal/target setting.***
5. **To measure fitness levels following injury, training blocks e.g. 'Pre', 'off' and 'in' season.**
6. ***Talent/Ability identification***

Principles of testing:

For fitness testing to be accurate and worthwhile key principles must be understood and applied:

- **Validity:** Tests must measure the component of fitness that they are supposed to. For example, you would not use the 'Multi-Stage Fitness ('Bleep test) as a 'speed' test.
- **Internal Validity:** Does the test administered determine (answer the question) and produce the required and desired data?
- **External Validity:** Does the testing apply to other populations and situations effectively
- **Reliability:** Is a test repeatable? For example, accurately calibrated scales will produce consistently reliable measurements. A testing protocol needs to be accurately repeated each time to achieve reliable results

- **Specificity:** Does the test being utilised measure appropriate and relevant movements and physical parameters that apply directly to a young athlete's movement, training and sporting activity?

The YAPS Battery:

TEST	REASON

Standing Height (cm)	***To measure a young person's current height and growth rate to inform and support planning, manging and monitoring of that child's physical development***
Seated Height (cm)	***To measure a young person's current height and growth rate to inform and support planning, manging and monitoring of that child's physical development and aid understanding of limb versus torso relative growth.***
Weight (kg)	***To have a basic understanding of a young person's body composition in relation to their height and age***
10 and 20 metre Sprint (Seconds)	***To measure the acceleration capability of a young athlete at a moment in time***
Standing Long Jump	***To measure the leg power in jumping horizontally (more specifically the power of the extensor muscles of the hips, knees and ankles)***
CMJ (Vertical Jump) **Arm Swing (cm)**	***To measure the leg power in jumping vertically (more specifically the power of the extensor muscles of the hips, knees and ankles)***
CMJ (Vertical Jump) (cm)	***To measure the leg power in jumping vertically (more specifically the power of the extensor muscles of the hips, knees and ankles)***
SQUAT JUMP (cm)	***To measure the concentric leg power in jumping vertically***
L-Test Left and Right	***To measure planned agility including acceleration, deceleration and turning left and right capabilities over a short distance.***
T-Test	***To measure planned agility including lateral movement and cutting speed, lateral ability and running backwards capability***
Med Ball Throw Chest Pass	***To measure the ability of the whole body and specifically the upper body's ability to exert pressing force at a high speed.***
Med Ball Throw lateral	***To measure the ability of the whole body and specifically the trunk rotators to exert force at a high speed.***

TEST BATTERY DESIGN

Standing Height

Equipment: Stadiometer, (Standing Height measure) or measuring tape, spirit level

Protocol:

- Subject stands bare feet against a wall or under a stadiometer
- Height is measured as the subject inhales
- Heels remain in contact with the floor
- Achieve optimal accurate neutral head on neck position for accurate measure
- If stadiometer isn't available, a spirit level and tape measure should be used and a mark/reference can be made on a tape on the wall

Seated Height

Equipment: Stadiometer, (Standing Height measure) or measuring tape, spirit level

Protocol:

- Height is measured as the subject inhales
- Upright seated position must be achieved prior to measurement with optimum posture
- Achieve optimal accurate neutral head on neck position for accurate measure

- If stadiometer isn't available, a spirit level and tape measure should be used and a mark/reference can be made on a tape on the wall

Weight

Equipment: **Accurate scales that are calibrated 1 x month e.g. Digital SECA scales**

Protocol:

- Subject stands on scales. Bare feet, arms by side, head up
- Measurement is recorded to the nearest 0.01kg by an independent tester
- Subject should wear light and dry clothing (complete pre- sweating due to other tests)
- Same scales are to be used at each testing session

10 and 20 metre Sprint

Equipment

Electronic timing gates should be set up at the start (0m), 10 metre and 20 metre intervals along the sprint line. Or Tester stands at finish point with Stopwatch.

Start _____10_____20

Protocol:

• The starting point is the marking tape which is placed 30 cm beyond the starting gates

• Two cones should be placed 1 metre beyond the final 20 metre mark to ensure that the subjects do not slow down prior to last gate.

Procedure (Timing Gates)

• Subject begins at the start in a 3 point start/standing start position.

• the subject starts the sprint in their own time and sprints the 10/20 metre distance as fast as possible (running through the line/final gate)

• Repeat three times.

Procedure (Stop watch)

- *Repeat as for timing gates methodology but tester begins timing on the action of the subject's first stride hitting the ground and stops timing as their torso crosses the finish markers at 20 metres*

Scoring

• During the 20m sprint, 10 metre splits are recorded for each of three trials. For the final result, only the best result for each split time is recorded regardless of which trial it occurred in.

CMJ (Vertical Jump) Arm Swing and No Arm Swing

Equipment: **Measuring tape mounted on wall, chalk for hands, Jump Mat**

Protocol:

- The subject stands side on to the wall and reaches up with the hand closest to the wall. Keeping feet flat on the floor, the point of the fingertips is marked and recorded.
- The subject then moves slightly away from wall, drops into a squat position (depth self-selected) and jumps vertically as high as possible using both arms and legs for propulsion. ***For the CMJ with no Arm swing the Jump mat is required and the subject must keep their arms anchored to their hips during the jump-flight time and height is then recorded***
- The subject attempts to touch the wall at the highest point of the jump
- The subject is permitted three attempts
- ***The difference between the reach height and the jump height is the score***
- The same process occurs on a jump mat but clearly the flight time is recorded and vertical jump height calculated by the electronic mechanism. The tester instructs the subject through usage of the mat

Squat Jump

Equipment: **Jump Mat**

Protocol:

- ***For the Squat Jump, the Jump mat is required and the subject must keep their arms anchored to their hips during the jump-flight time and height is then recorded***
- ***For the Squat jump there is no 'dip' or pre-load CMJ permitted. The subject sinks into a 3/4 squat hold position and on the command of the tester explosively jumps upwards from that static squat position***
- The subject is permitted three attempts
- The same process occurs on a jump mat but clearly the flight time is recorded and vertical jump height

Standing Long Jump

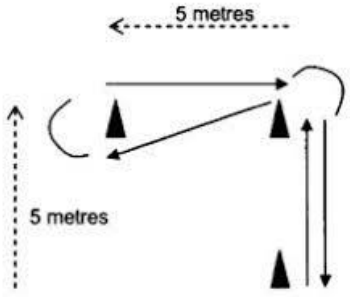
Equipment: **Stadiometer, (Standing Height measure) or measuring tape**

Protocol:

- Subject stands on two feet square and static at the end of a marked jumping area or on a standing long jump mat.
- Their toes need to be on or behind the 'start position' line (not over)
- They swing their arms for 'wind up' and to generate CM momentum
- In their own time they then explosively jump forwards horizontally
- Tester should tell subject to jump for distance and height, driving their hips forwards as they propel their body as far as possible.
- The Tester measures where their heels or last part of their body lands for a final measurement.
- The subject is permitted three attempts

L Test Left and Right

Equipment: Cones, stop watch

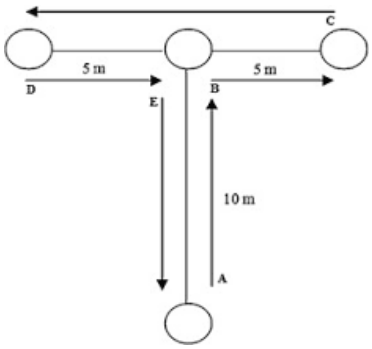


Protocol:

- Subject begins in three point or standing sprint start position at the first cone 1
- Subject accelerates 5 metres forwards then turns **either left or right** and heads at maximal speed to cone three (on the inside)
- Subject then turns and returns to cone 2, turning and then continuing sprinting back to cone 1 and the start finish line. The tester records the subject's time when they return to and break the start finish at cone 1. (Or the timing gates record the body breaking the sensors)

T- Test

Equipment: Comes and stop watch



Protocol:

- Subject begins in three point or standing sprint start position at the first Cone 1(A)
- Subject accelerates forwards 10 metres then turns right at Cone 2 (B) and heads at maximal speed with a lateral shuffle to Cone 3 (C) (on the inside facing forwards)
- Subject then turns left and sprints to cone 4, turning and then shuffling right back to Cone 2 (facing forwards)
- Subject then runs backwards to Cone 1 (staying facing forwards) and the start finish line. The tester records the subject's time when they return to and break the start finish at cone 1. (Or the timing gates record the body breaking the sensors)

Med Ball Throw Chest Pass

Equipment	**1kg,2, 3kg medicine ball, Measuring tape, cones or measure markers (on grass)**
Procedures	• The subject begins standing face or (straight)-on, square stance position at the designated start line. • The subject holds the medicine ball in two hands, on the back/sides of the ball with a 'chest pass' grip • The subject's arms are held into their chest in the 'loaded flexed start position' • The subject then propels the ball maximally from this position after a body weight squat into a jump release (whole body triple extension and elevation prior to release) with arms being extended forcefully from the loaded flexed chest pass position and the ball is released for maximal height and distance. -Record the distance to the nearest centimetre.
Scoring	-Three throws are permitted and the best of the three throws is recorded.

Med Ball Throw lateral

Equipment	**1kg,2kg, or 3kg medicine ball, Measuring tape, cones or measure markers (on grass)**
Procedures	The subject begins standing side-on, closed stance position at the designated start line. • The subject holds the medicine ball in two hands, right hand at the back of the ball and left hand under the ball for a right side throw (vice versa for the left side throw). • The subject's arms are nearly straightened in front of the body and are held in a near-horizontal plane. • The Subject then propels the ball maximally from this position. The subject is permitted to use trunk/shoulder rotation (take a backswing) and attempt to sling the medicine ball. He or she is not permitted to step or bend the arms significantly. The arms should move in a horizontal plane. – Encourage a release of approximately 45 degrees to maximize distance achievable. – Record the distance to the nearest centimetre. **Scoring** • Three throws are permitted and the best of the three throws is recorded. • Repeat the test on the left hand side.

Testing Growing Athletes:

Testing young people is of great value but it also carries with it huge responsibility and a range of potential pit falls. Clearly for a developing youngster to experience different types of fitness 'testing' from an early age has a range of benefits:

Benefits of testing young growing athletes:

- Gives young people targets to work towards
- Shows a young athlete the progress they are making
- Enables coaches to gain a great deal of knowledge about each child's current and potential athleticism.
- Enables coaches to be more accurate in terms of programme and training cycle design.
- Helps coaches motivate players.
- Enables young athletes to get used to the process of training and testing as part of an evidence based programme tailored to their individual needs
- Helps a child's development accelerate and supports the process of training for a healthy lifestyle.
- It can be a lot of fun for young athletes who are naturally competitive and want to test themselves and compare themselves against their peers and

Important further testing considerations:

- It is imperative that results feedback is handled in a constructive manner with young people. If handled poorly a young person can lose motivation and that situation needs to be avoided.
- Maturation and growth data needs to be a key consideration when judgements are made about a young person's athleticism and fitness levels at that moment in time. Often young athletes are labelled as being poor in an area when their training age, experience and stage of maturation has not been accounted for.
- Finally, any player participating in any fitness testing who is under the age of 16 years must have written consent from their parent or legal guardian prior to the testing.

Key concepts and definitions:

Speed *'The ability to move quickly across the ground or move limbs rapidly to grab or throw'*.

Acceleration, maximal speed of movement, and also speed maintenance are key components of speed. Movement speed requires good strength and power in addition to a high proportion of fast twitch muscle fibres, it is vital to have efficient mechanics of movement to optimize the muscle power for the most economical movement technique.

This is a particularly relevant consideration when working with young athletes. Whilst muscle fibre proportions are genetically determined, all young people can be taught excellent acceleration, deceleration and all-round ***'speed mechanics'*** from a very early age so that they can maximise their genetic potential as they transition from child, to adolescent into a young adult.

Agility *'The ability to start, stop and change direction'*

Agility is often defined as ***"a rapid whole body movement with change of velocity or direction in response to a stimulus".*** Agility can be influenced by strength, balance, coordination, position of the centre of gravity, as well as running speed and efficiency.

Sports speed is made up of many sub-components such as ***acceleration, deceleration***, and ***reactiveness, changing direction***, maximal velocity, speed maintenance, speed-endurance and ***repeated sprinted ability (RSA).***

- ***Acceleration*** is ***"the rate at which an athlete can change or increase their velocity"*** and it is the ability to overcome inertia through the application of force into the ground. ***Acceleration is a product of stride frequency, therefore requires high levels of concentric strength and force production.***

- ***Deceleration*** is the opposite of acceleration and is therefore ***"the rate at which an athlete can reduce their velocity".*** This is equally if not more important than being able to accelerate quickly as most sports require athlete(s) to be able decelerate and change direction at high velocities. ***Deceleration requires large amounts of eccentric strength especially, in the quads***

and hamstrings and in addition glute activation and control. If a young athlete lacks strength in these areas their risk of injury will be increased when decelerating at high speeds. ***This is even more prevalent as a risk in adolescent female populations.***

- ***Reactiveness or reactive speed*** refers to both the cognitive processes between the brain and the body – the ability to see, process and react to an unpredictable stimulus. It is also the physiological processes that occur within the musculo-tendon unit (MTU) in order to produce-reduce and reproduce force in the shortest possible time. This is a physiological mechanism that occurs during Plyometric training. It is apparent that reactiveness is an essential skill requirement in many sports.
- ***Change of direction (COD)*** more commonly known as agility or multi-directional speed is a key speed component for man, court or field based activities. It is a combination of many of the above qualities; acceleration, reactiveness, deceleration and may also incorporate ***turning*** and/ or ***cutting*** actions as well. Similarly, to accelerating and decelerating, this requires large amounts of both ***concentric and eccentric strength*** in order to be able to perform these actions efficiently, whilst also minimising the risk of injury.

Acceleration Phase

This phase is characterised by an ***excessive forward lean position of the body***, although good posture and alignment between the shoulders, hips and ankles should be maintained. ***The foot contact should be behind the hips in order to produce horizontal forces to propel the athlete forward.***

Ground contact times will be longer during this phase and strong forceful steps should be encouraged. ***Young athletes should be coached to lower their centre of mass and try and adopt the forward lean position.***

Acceleration Model

The key coaching points that should be re-enforced during the acceleration phase are as follows;

- ***'Toes to shins'*** – encourage the athletes to ***maintain ankle dorsiflexion*** in order to increase ground reaction forces and minimise ground contact times.
- ***'High knee drives'*** to increase downward force production capacity.
- ***Hard forceful steps*** on ground contact to increase ground reaction forces.
- ***Maintain good posture*** and avoid excessive trunk movement to ***avoid energy leaks***.

Deceleration Phase

This phase is unfortunately poorly coached and often neglected. This is problematic because many injuries that occur in young people result due to their inability in terms of techniques and strength to

control and reduce speed. The analogy of having a very powerful car with very poor brakes and the risks driving it rings true here. 'Start stop' and change of speed with direction drills are critically important along with the underpinning physical literacy strengthening required of the posterior chain. The key coaching points in the deceleration phase should be introduced as follows;

- Young athletes should complete regular 'start stop' drills and accelerations into decelerations training as part of a robust athletic development agility programme. These should be completed with two feet, single foot , angled foot 'stops' or finishes.
- Turning and cutting mechanics need to be coached 'out of' deceleration situations
- Young people shout be taught how to change or '***drop their body level'*** and head/centre of mass position, ***'chop'*** or adjust their stride mechanics.
- ***'Backwards running'*** and '***turning mechanics'*** should be coached and practiced.
- Appropriate strength training with an awareness of developing ***eccentric control*** must be in an integrated training programme to support safe and effective deceleration development.

Reaction Drills

As most sports require a reactive element to either an object or an opponent it is important that this is also trained within the speed component. There are many ways in which this can be achieved and quite often it's about being creative within the context of the sport. Some examples of different ways to do this include;

- ***Ball reaction drills*** – Very sport specific and gain good cross over benefit
- ***Partner reaction / mirror drills*** – These are good drills to use to enable young athletes to better respond to stimuli and opponent movement patterns
- ***Cone drills*** – Planned agility sequences can be laid out in a myriad of directions and safe efficient movement patterns and mechanics can be achieved-before external stimulus is included. (critical when young people are learning movement skill and if they are coming back from injury)
- ***Coaching cue/Command drills*** – Provide CNS development and reaction skill development

Agility Drills

There exists an endless list of agility drills that could be provided including those ones shown in the testing section. When training agility it is important to refer to the necessary movement patterns

required within the sport and to design drills that specifically replicate these movements. There are many different patterns that can be trained under the term of "agility" including;

- ***Cutting –*** Is the ability to accelerate, decelerate and then accelerate at a different angle (10-90 degrees). This requires good strength in both the frontal and sagittal planes and is an important quality required for many sports. An example cutting exercise would be the zigzag drill over 20-30m. The athlete should be encouraged to lower their ***COM*** and explosively drive off of the outside leg when pushing off.
- ***Turning and twisting*** –Requires the athlete to manoeuvre or turn around an object or person. The mechanics are slightly different to that of cutting and an example would be the Illinois agility drill.
- ***Lateral movements / shuffling*** – Requires the athlete to be able to move laterally or side to side as quickly as possible, which could be in the form of shuffling or by using the cross step to move. An example of this type of drill would be the T-Drill.
- ***Backwards movements / backpedalling***–This is often a movement that is overlooked when it comes to training. Athletes often spend time training on speed running forwards but often neglect backwards running. Backwards running can be used as a good conditioning tool for the hamstrings and should be trained if it is a necessary requirement for the sport. Backwards running can be trained in isolation or integrated within a multi-directional agility drill.

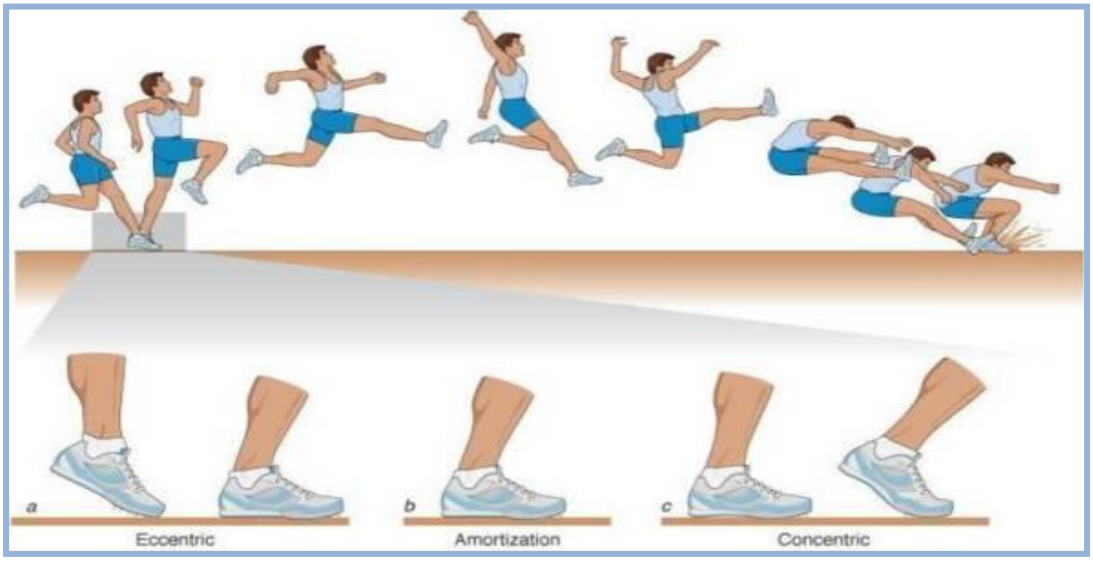
Jump training and 'Plyometrics' with youth athletes

Physiological Considerations: Stretch Shortening Cycle:

- The mechanism of the ***stretch shortening cycle (SSC)*** is the predominant factor that makes Plyometric effective and consists of three distinct phases, ***the lengthening (eccentric)*** component, the amortization (transition) phase and the concentric component.
- The lengthening phase is the pre stretch of the muscle whereby the muscle is lengthened and ***elastic energy*** is generated to provide a greater and faster contraction during the subsequent concentric contraction.
- The ***amortization phase*** is the ***transition time between the eccentric and the concentric*** components; this is often referred to as the ***ground contact time***. The amortization phase needs to be ***as short as possible*** or the elastic energy generated will be dissipated.

- The concentric phases is normally referred to as the ***take-off or push-off*** during a jumping or bounding movement, and the amount of force produced and rate of force development will be dependent upon how much pre stretch occurred within the muscle and how quick the amortization phase was performed. An example would be to use the elastic band analogy, for example if you were to flick an elastic band, the further the band was pulled back (stretched) and released the further the elastic band would travel, similarly to what happens to a muscle during a Plyometric action. In order for an exercise to be classed as a ***true Plyometric exercise the amortization phase must be less than 0.2s.***

Phases of the stretch shortening cycle



'Jump training' for younger pre- adolescent athletes or inexperienced youth:

A methodical staged approach:

A good example of this concept of building the progressions can be seen below as we stage a young athlete's movement journey with the bounding for height and distance progressions. You can see from the table below that there is a logical staged progression and that we do not miss stages out when developing towards an advanced body weight plyometric progression:

Bounding Progression

L1: left to right on the spot switches
L2: left to right switches with jump
L3: Forward step bounding with 3s hold each leg
L4: forward bound increased height with 3s hold
L5: 45 degree versions of L3/4
L6: full reactive bounding quick contacts

Clearly prior to this bounding stream of progression there is also stages of basic movement competence including initial jump and landing mechanics and physical literacy pattern progressions like squatting and lunging. The take home message – 'young people need to earn the right to progress if we are to keep them developing safely through appropriate regression and progression as appropriate.

Example Plyometric exercise progressions.

	Level 1	Level 2	Level 3	Level 4	Level 5
Vertical	Squat Jump	Box Jump	1 leg Box Jump	Depth Jump	1 leg Depth Jump
Horizontal	Broad Jump (double)	Linear Leap	1 Leg Linear Leap	Bounding	Resisted Bounding
Lateral	Lateral Jump (Double)	Lateral Leap	Lateral Hop	Lateral Leap to Box	Diagonal Bounding
Reactive 1	Pogo Jumps	1 Leg Pogo Jumps	Pop-Float-Skip	SL Pop-Float-Skip	MB OH Pop-Float-Skip
Reactive 2	Tuck Jumps	1 Leg Tuck Jumps	High Hurdle Jumps	MD Hurdle jumps	MD Hurdle & Box Jump Combo's

Youth Plyometric Assessment and considerations:

Are 'plyometrics' safe for adolescent youth?

Before prescribing Plyometric exercises to a young athlete their ability to effectively perform a Plyometric movement needs to be assessed to ensure that they not only possess the necessary technique and physical qualities required but are also not at risk of injury through technical or strength deficiencies.

The following questions need to be answered to determine how competent a young athlete is and therefore what level of Plyometric training they are ready for;

- Can the athlete perform the movements well? (squatting, jumping & landing)
- Are they strong enough to absorb / reduce the impact forces (stiffness)?
- Do they possess symmetry? Left vs. Right?
- Are the reactive? (Efficiency of SSC)
- ***Has the young person completed a progressive programme of landing mechanics, hop and hold/stick movements and are they able to complete them with excellent stability and movement quality?***

Plyometric Coaching Points

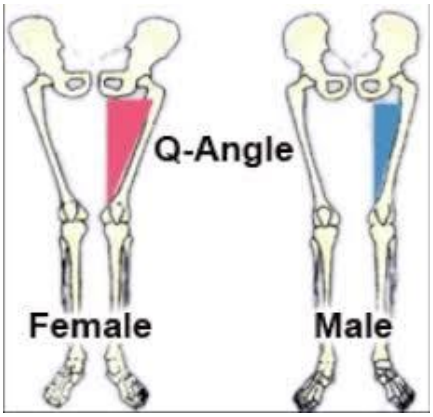
It is important that Plyometric exercises are coached and executed correctly in order to optimise the force production, whilst also minimising the risk of injury. The following points are key things to be emphasized when coaching Plyometrics with an athlete;

- ***Maintain good posture*** – head and chest facing forward (athletic position)
- Land on mid-forefoot, the heels should not contact the floor
- ***Minimise ground contact times*** – landing on hot coals
- Maintain ankle dorsiflexion – Toes to shins
- ***Avoid knee valgus***
- ***Regress jump exercise immediately if poor landing mechanics witnessed***
- ***Stop a 'jump's training session if a young person identifies 'experiencing pa***

The table below identifies some different tests that can be used to assess the different qualities required by an older Youth athlete, to be able to effectively participate in a Plyometric training programme:

Phase 1	Phase 2	Phase 3	Phase 4
Movement Screen	Strength testing	Jump Testing	RSI Testing
Bi-lateral Squat Unilateral Squat Box Jumps Ankle Mobility (dorsiflexion)	Squat Strength (1-3rm) – 1.5 x BW SL Squat or leg press strength	Squat jump CMJ EUR Single Broad Jumps (bi-lateral & unilateral)	30cm drop jump (RSI) Repeated CMJ's (10 for time) Repeated broad jumps

Considerations with youth female athletes:



- Chronologically earlier completion of puberty and physical adolescence than in male populations.
- Significant biomechanical, physiological changes through puberty can affect movement pattern competency, efficiency and –potential quality.
- Increased hip 'Q' angle increases risk of Valgus and sub-optimal leg movement patterns particularly in dynamic movement (e.g. cutting COD) and jumping settings.
- Reduction in comparable Hamstring strength with Quadriceps can lead to injury markers
- 30% greater risk of ACL ruptures in post pubertal female populations
- Hormonal and menstruation considerations during training meso-cycles

Youth movement strength progressions

With young people it is important when completing resisted or loaded movement training, to apply strength training scientific principles. These principles enable smart, appropriate and safe ***(SAS) training*** habits and behaviours. Keeping our young people moving progressively with increased loading progressions is critical. Sound applied knowledge enables an ***exciting, engaging and enabling*** experience to occur. As we repeat regularly though, young people must at the core of everything '***earn the right' to progress the complexity, speed, volume and loadings of movements*** if they are to have a positive and safe training/learning experience.

Strength Training Principles-applied to youth:

The SAID principle is one of the most important basic concepts in Fitness. It is an acronym which stands for ***Specific Adaptation to Imposed Demand***. It means that when the body is placed under some form of stress, it starts to make adaptations that will allow the body to get better at withstanding that specific form of stress in the future.

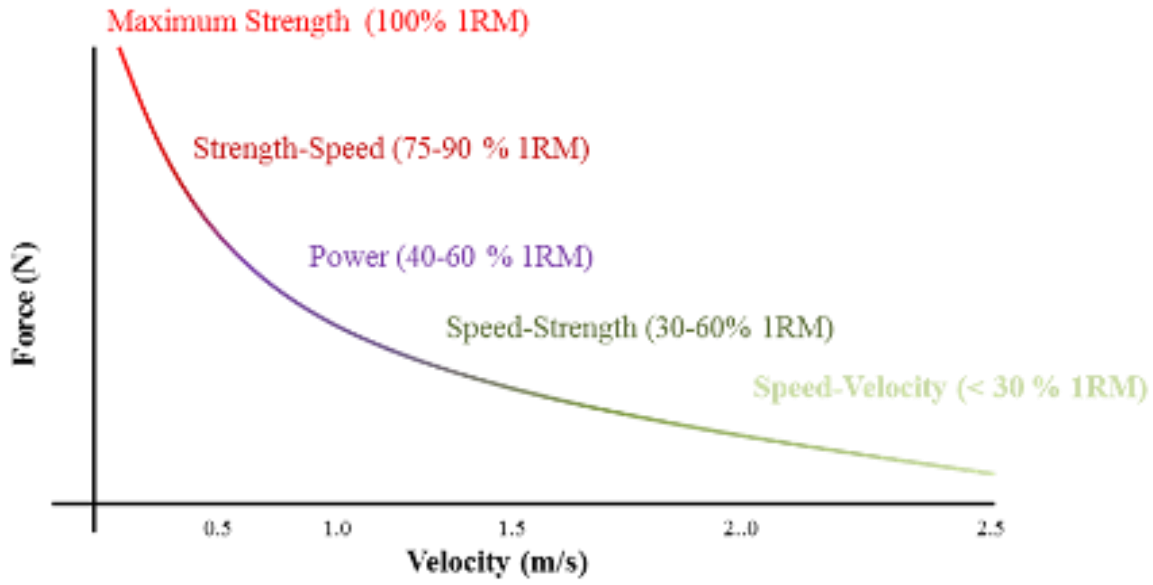
An example of this would be for a young athlete who wants to get stronger, if they regularly lift heavier weights over a training phase/mesocycle and apply the ***principle of progressive overload*** then in theory the ***contractile and non-contractile*** tissues will adapt and get stronger, although ***this will be specific to the type of stimulus applied.***

This is known as the ***dynamic correspondence theory,*** this concept emphasises that all exercises for specific sports/activities be chosen to enhance the required sport motor qualities/movement patterns.

Exercises and/or training techniques can further be classified into categories such as ***general physical preparation (GPP)*** or ***special physical preparation (SPP).*** Evaluating the effectiveness of Dynamic Correspondence can only be decisive with the use of the force velocity curve alongside this.

The force velocity curve shows an ***inverse relationship between force and velocity (e.g. the heavier the weight lifted (force), the slower the weight is lifted (velocity); conversely, the lighter a weight, the faster it is lifted).*** Therefore, different types of training occur on different parts of the force-velocity curve.

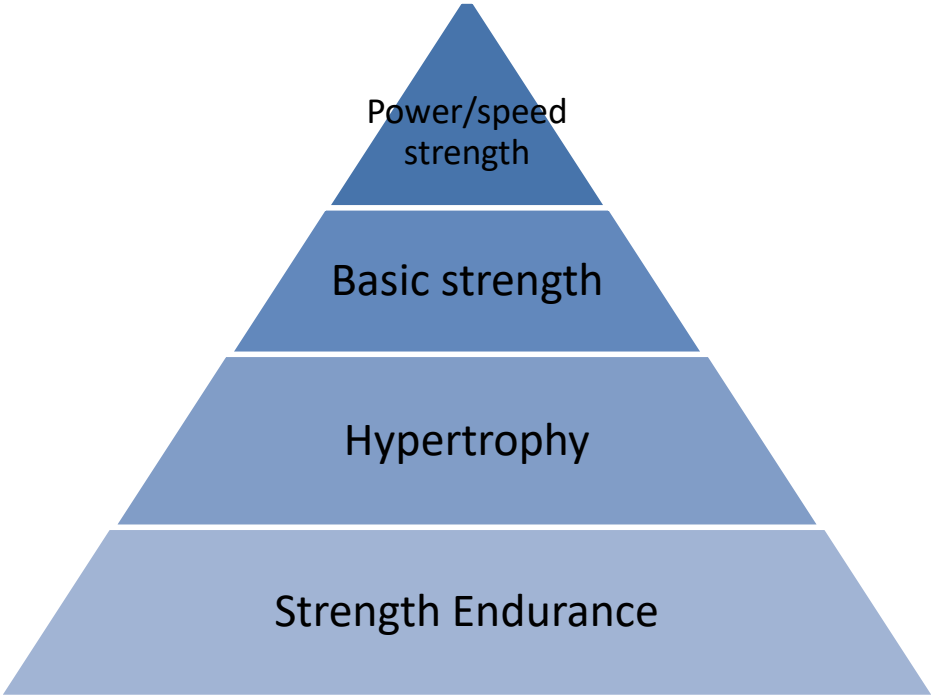
The force-velocity curve



Selecting the right training type and its application to other activities requires a Youth Strength and Conditioning coach to understand what modalities of training are appropriate for the young people they are working with based on answering some key questions:

- What are their movement capabilities across Literacy qualities? (e.g. Squat, Lunge, Pull)
- Have they earned the right to progress? -Loadings, velocities, volume training type?
- What are the requirements of the activity the young people are training for (needs analysis- what type of training do they 'need' to be doing?)

Young people must build a pyramid of strength qualities as they earn the right to progress:



Guidelines based on training status and experience/training age

- Novice = 2-3 sets
- Intermediate = 3-4 sets
- Advanced = 4-5 sets

This table illustrates the recommended training prescriptions for the different training modalities:

	Sets	Reps	TUT (per set)	No of exercises	% Load	Rest
Power	3-5	1-5	5-10s	3-5	Exercise Specific	2-3m
Strength	3-5	1-6	10-30s	4-6	>80% 1RM	2-5m
Hypertrophy	4-6	6-12	45-90s	6-8	60-80% 1RM	60-90s
Muscular Endurance	2-3	>12	60-120s	6-8	40-60% 1RM	30-60s

Exercise Prescription Progressions-'Earning the right' to progress:

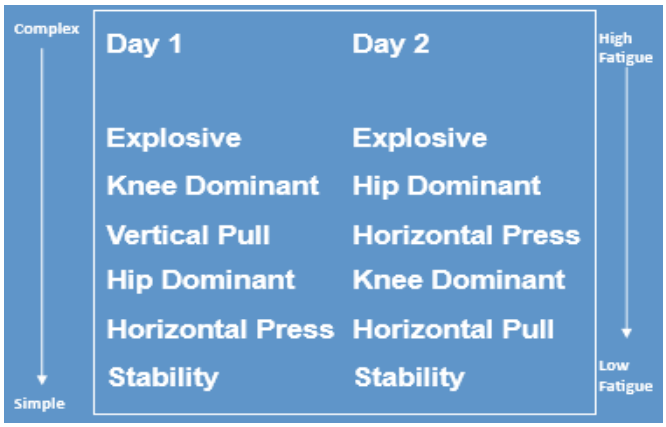
Bi-Lateral Squat Patterns	Unilateral Squat Patterns	Lunge Progressions	Olympic Lifts	Plyometrics
Overhead Squats	Split Squat	Reverse Lunges	Pulls From Hang	Landing (force acceptance)
Front Squats	Bulgarian Split Squat	Forward Lunges	Catch from Hang	Jumping (force production)
Back Squats	Single Leg Squats	Incline Lunge / Step Up	Pulls from floor	Reactive Jumps
Box Squats		Decline Lunge / Step down	Catch from Floor	Unilateral

Exercise Order considerations with Young athletes:

Lower body training Exercise order example

Number	Exercise	Rationale
1	Power Cleans	Requires maximal force production and co-ordination
2	Box Jumps	Requires maximal RFD
3	Back Squat	Heavy compound movement
4	TRX Pistol Squat	Unilateral movement
5	Glute Ham Raise	Accessory exercise – posterior chain

A more advanced exercise order model as 'training age/experience' increases:



Key considerations for Strength training:

- Athletes earn the right to progress to the next 'level' of progression by achieving the previous level with exemplary technique and form. If this is not present they have not 'earned the right to advance'.
- Pay attention to strict quality of exercise delivery by young athletes
- If any athletes experience 'pain' cease any continuation of an exercise and review the situation with the athlete.
- Maintain a focussed and fun environment through varied prescription orders and routines when completing these exercises so the young athletes stay engaged with developing these competencies.
- When completing strength and power training the focus should always be safety
- Adhere to highlighted guidance
- We 'train movements not muscles'
- Athletes may need prescriptions that initially require regressions.
- When athletes advance specific movements and more advanced variations of movements can be prescribed.
- Do not 'chase load' but embrace progression and encourage logical 'load progressions' without fear if technique is excellent!

Decision making when working with youth populations

Scenario 3: 'New athlete-no time'

You do not have time to complete a full screen. A young 11 year old boy has joined one of your training groups (He has confidence issues. Doubts about training and wants to fit in and is 'not sure' he has also arrived 10 minutes late You do not have time to complete a full screen. You also have 8 other young athletes in your session (12-18 years already working) you have 10 minutes to make a functional assessment and get him working and engaged there are 45 minutes left in the group session.

- What do you do?
- Key immediate, short, medium and long-term considerations?

Scenario 4: 'Big rugby player' no range

You have a 16 year old rugby player-Second Row (6ft 4ins). It is his first training session and he wants to 'get bigger and stronger' (he has been told by the First XV/Academy coach needs to 'lift'). He has a poor 'hinging at the hip' back squat and a poor functional screen with below average scores across the board including single leg instability, poor landing mechanics. He and his coach just want him to get big, use creatine and lift!

- What do you do?
- Key immediate, short, medium and long-term considerations?

Scenario 5: 'Distressed youth tennis player'

A Male tennis player-14 years old (going through PHV growth spurt) has been complaining of back pain. You have been completing core work that has eased the pain a bit. His Father wants him to play and keep training hard. Pain is moving across his lumbar spine around L4/L5. New physiotherapist thinks three more sessions should 'fix it'. You know the boy and think he is very tough mentally.

- What do you do?
- Key immediate, short, medium and long-term considerations?

Useful links:

Dr Avery Faigenbaum, *https://hes.tcnj.edu/faculty-profiles/avery-faigenbaum-2/*

Kelvin Giles MA, Cert Ed ***http://www.movementdynamics.com/about/***

Dr Stuart M. Mcgill ***http://www.backfitpro.com/about-us/***

Dr Gregory D Myer ***https://www.cincinnatichildrens.org/bio/m/greg-myer***