
# USING LTAD TO PROGRAM FOR A MIDDLE SCHOOL ATHLETE AND A HIGH SCHOOL ATHLETE: PART 1—GENERATING AN ATHLETIC PROFILE

RICK HOWARD, MED, CSCS,*D, USAW

## PRACTICAL APPLICATION OF LTAD

Based on the popularity of existing models of long-term athletic development (LTAD), sports coaches are interested in the practical application of LTAD for their athletes (3,5,10). This article is intended to help sports coaches better understand programming for their athletes (at the youth level, the sports coach often is the strength and conditioning coach). The need also exists to better educate many strength coaches that work with youth, or are interested in helping implement LTAD for youth. This article applies LTAD principles to guide the process of generating an athletic profile (part 1) and sample program design (part 2) for a middle school athlete (for the example in the article, we will use a student who is pre-peak height velocity [pre-PHV]) and a high school athlete (for the example, we will use a student who is post-peak height velocity [post-PHV]). Recognizing that coaches are most often faced with an uncertain combination of pre-PHV (not yet adolescents) and post-PHV (adolescents), the practical application is not always so easy or straightforward for coaches working with young athletes.

## DEFINITIONS

To better focus on the process of generating an athletic profile, the following definitions are helpful:

- Athlete: anyone with a body who is performing within their given level of endowment (2,12).
- Athletic readiness: Adequate preparation of the biological, social, physiological, and psychological domains for sport and competition (1).
- Athleticism: the ability to repeatedly perform a range of movements with precision and confidence in a variety of environments, which require competent levels of motor skills, strength, power, speed, agility, balance, coordination, and endurance (5).
- Athletic profile: after conducting valid and reliable testing under controlled conditions, the process of creating a summary document that critiques test scores against known norms in order to be used for safe and effective program design.
- Chronological versus maturational versus training age (6,7):
  - » Chronological age: number of years, months, and days since birth.
  - » Maturational age: refers to the genetic, biological, and physical development from conception through adolescence. Chronological age and maturational age are not the same and the effect of maturational age on chronological age needs to be addressed in positive youth development programs. Maturational age can be two years on either side of the chronological age.
  - » Training age: total amount of time spent engaged in a specific type of training, whether strength training, agility, speed, endurance, etc. (training age is exercise specific). Each type of training must be considered separately. Training age is also sometimes referred to as technical training age.

- LTAD: habitual development of "athleticism" over time to improve health and fitness, enhance physical performance, reduce the relative risk of injury, and develop the confidence and competence of all youth (5).
- Physical literacy: the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life (9).
- Peak height velocity (PHV): the period of time in which an adolescent experiences their fastest upward growth in their stature, best measured 2 – 3 times per year from age six for girls and age eight for boys (also known as the maturity offset or growth spurt ) (11).
- Post-PHV: the time after PHV, typically at some point during adolescence, but may be earlier in years than the defined years for adolescence (girls aged 12 – 18 years and boys aged 14 – 18 years) especially for aspiring athletes who physically mature more quickly than their peers (11).
- Pre-PHV: the time before PHV, typically childhood, but may be in adolescence, especially for aspiring athletes who physically mature more slowly than their peers (11).
- Youth: represents both children (up to the approximate age of 11 years old in girls and 13 years old in boys) and adolescents (typically including girls aged 12 – 18 years old and boys aged 14 – 18 years old) (5).

## GENERATING AN ATHLETIC PROFILE

To generate an athletic profile, coaches should first conduct appropriate testing. In order to determine what appropriate testing is for each athlete, coaches need to first understand the concepts of chronological versus maturational versus training age, as well as how they align with LTAD goals. A summary of these concepts is presented in Table 1.

One of the most glaring observations is that a coach often has athletes of differing chronological, maturational, biological, and training ages within a sport level (middle school or high school). This variation means that a "one size fits all" approach to athletic profiling and subsequent programming is inappropriate. Moreover, expecting every athlete at middle school or high school to have the same level of maturity (physically or psychosocially) is not prudent. This is why testing and programming for youth requires requisite knowledge of growth and development, psychological development, and LTAD. Measuring PHV can be troublesome for coaches if regularly scheduled measurements are not started early enough (age 7 for girls and age 9 for boys) when the aspiring athlete is in childhood (13). Simple but consistent and accurate tools (preferably the same for all measurements) are needed to conduct PHV assessments, which include: weight scale, ruler attached to the wall, and a firm bench. Any error in calculations can change the age at PHV measurement and undercalculate or overcalculate age at PHV. There are several formulae available to measure age at PHV, all of which are feasible for coaches, but require remembering mathematical operations. For example, the formulae established by Mirwald et al. as recommended by Lloyd et al. (Table 2) (6).

Coaches may consider the testing categories found in Table 3 in order to establish the athletic profile. Fundamental motor skill mastery is critically important to LTAD as it, along with muscle strength, builds the foundation for all other movements (5). Fundamental movement skills include locomotor movements such

**TABLE 1. DIFFERENCES IN CONCEPTS TO EXAMINE BEFORE CONDUCTING ATHLETIC TESTS**

| CONCEPT | TYPICAL MIDDLE SCHOOL | TYPICAL HIGH SCHOOL |
|---|---|---|
| Chronological Age | 11 – 14 years old | 14 – 18 years old |
| Maturational Age | 9 – 16 years old | 12 – 20 years old |
| Training Age | 0 – 6 years old | 0 – 10 years old |
| LTAD Goals | Should have mastery of fundamental motor skills, sport sampling, general physical preparation, development of muscle strength and sport skills, physical literacy, attention to volume of training/playing, rest, and nutrition. | May narrow focus to one or two sports but also may continue to sample/play multiple sports, general physical preparation with enhanced sport skills, muscle strength and power, volume of training/playing, rest, and nutrition. |

**TABLE 2. EQUATIONS FOR DETERMINING AGE AT PHV**

| EQUATION FOR MALES | EQUATION FOR FEMALES |
|---|---|
| (-29.769 + 0.0003007) x (leg length and sitting height interaction - 0.01177) x (age and leg length interaction + 0.01639) x (age and sitting height interaction + 0.445) x (leg by height ratio) | (-16.364 + 0.0002309) x (leg length and sitting height interaction) + (0.006277 x age and sitting height interaction) + (0.179 x leg by height ratio) + (0.0009428 x age and weight interaction) |

as running, skipping, and hopping; object control movements such as kicking, throwing, and striking; and body awareness movements such as static balance, dynamic balance, and landing. Before more complex sport-specific skills can be integrated into the training program in adolescence, coaches should consider checking that the foundational motor skills needed to complete the movement pattern are properly performed.

Coaches will notice that the testing categories are not that different; the difference is in the intention of the process. For pre-pubertal youth, the focus is on developing the fundamental skills and fitness attributes that can be applied in a sport setting or as a basis for continued recreational and personal sports and fitness. For this example, the pubertal youth should focus on competitive sport success. Pre-pubertal youth should continue to focus on improving general athleticism while pubertal youth can apply that athleticism in a sport setting.

## THE ATHLETIC PROFILE

Recognizing the differences in desired outcomes for pre-PHV and post-PHV youth helps to develop an athletic profile. Essentially, the pre-PHV athlete should focus on mastery of motor skills, broad application of athletic skills (physical literacy), and continued integration of muscle strength using a variety of implements. This includes locomotor skills, object control skills, and body awareness. The development of fundamental motor skills is also demonstrated by the ability to establish proper athletic positioning via the universal athletic stance, body awareness when shifts in position occur, and development of movement abilities in all three cardinal planes of motion (13). The post-PHV athlete should apply strength and skill to the desired sports or activities. While there are many fitness attributes and many tests for each attribute, the following sample athletic profile worksheet provides comparative norms (typically 50th percentile) for pre- (Table 4) and post-PHV (Table 5) youth (4).

**TABLE 3. SAMPLE TESTING CATEGORIES TO DEVELOP ATHLETIC PROFILE**

| PRE-PUBERTY | PUBERTAL |
|---|---|
| Fundamental motor skill mastery | Specific sports skills |
| Development of basic strength and other fitness attributes | Strength |
| Proper athletic stance | Power |
| Exercise technique for a variety of exercises that encompass the 10 fitness attributes of LTAD | Agility |

**TABLE 4. SAMPLE ATHLETIC PROFILE WORKSHEET FOR PRE-PHV YOUTH**

| FITNESS ATTRIBUTE | EXERCISE/MOVEMENT | ATHLETE SCORE | PRE-PHV NORMS (4) |
|---|---|---|---|
| **Fundamental motor skill mastery** | Fundamental motor skill mastery checklist (8) | | Meets standard |
| Proper athletic stance | | | Meets standard |
| Body awareness | | | Meets standard |
| Cardinal planes of motion | | | Meets standard |
| **Exercise technique** | Basic exercise technique for foundational movements such as squat, lunge, and hinge | | Meets standard |
| Agility | Pro-agility | | Not found |
| Balance (static) | Stork stand | | 30 s (boys)<br>20 s (girls) |
| Cardiovascular endurance | One-mile run | | 6:57 min (boys) 8:00 min (girls) |
| Power (horizontal) | Standing broad jump | | 59 in. (boys)<br>56 in. (girls) |
| Power (vertical) | Vertical jump | | 10.5 in. (not gender differentiated) |
| Speed | 40-yard dash | | 5.97 s (boys) |
| Strength (absolute) | Hand-grip dynamometer | | 29.7 kg (11 – 12 year olds) |
| Strength (relative) | Pull-ups/push-ups | | 34 (boys) 21 (girls)/<br>8 (boys) 3 (girls) |

For example, landing is a fundamental movement skill that has application for post-PHV youth. For pre-PHV, the emphasis is on the phases of levels of development of learning to land: discovering, developing, and consolidating (8). Table 6 summarizes sample phases that could be applied for a specific skill ("stability: landing" was chosen for the example in Table 6 but any fundamental movement skill could be used).

For Post-PHV, coaches should be aware of whether each athlete has properly consolidated the fundamental movement before applying it to the particular sport. From the example in Table 5, the coach can see if the athletes can fall forwards at speed, particularly from the different levels and directions of the sport.

**TABLE 5. SAMPLE ATHLETIC PROFILE WORKSHEET FOR POST-PHV YOUTH**

| FITNESS ATTRIBUTE | EXERCISE/MOVEMENT | ATHLETE SCORE | POST-PHV NORMS (4) |
|---|---|---|---|
| **Fundamental motor skill mastery** | Fundamental motor skill mastery checklist (8) | | Meets standard (in combinations for sport skills) |
| Proper athletic stance | | | Meets standard |
| Body awareness | | | Meets standard |
| Cardinal planes of motion | | | Meets standard |
| **Exercise technique** | Exercise technique for foundational exercises as well as sport-relevant exercises | | Meets standard |
| Agility | Pro-agility | | 5.02 s +/- 0.24 s |
| Balance (static) | Stork stand | | 31 – 40 in. (boys)<br>16 – 32 in. (girls) |
| Cardiovascular endurance | One-mile run | | 5:57 (boys)<br>7:58 (girls) |
| Power (horizontal) | Standing broad jump | | 79 in. (boys)<br>65 in. (girls) |
| Power (vertical) | Vertical jump | | 20.5 in. (boys)<br>15.5 in. (girls) |
| Speed | 40-yard dash | | 4.76 s (boys) |
| Strength (absolute) | Hand-grip dynamometer | | 43.4 kg +/- 7.3 kg (17 year olds) |
| Strength (relative) | Pull-ups/push-ups | | 15 (boys) 2 (girls)/<br>56 (boys) 28 (girls) |

**TABLE 6. EXAMPLE OF FUNDAMENTAL MOVEMENT SKILL (STABILITY: LANDING) (8)**

| LEARNING PHASE | ACTIVITY NAME | MOVEMENT SKILLS/CONCEPTS |
|---|---|---|
| Discovering | Landing on feet | Jumping, landing, balancing, space awareness (levels and directions), and relationships (with equipment) |
| Developing | Landing on hands falling forwards | Falling to land on front support and body and space awareness |
| Consolidating | Falling forwards at speed | Forward shoulder roll at speed from different levels and directions |

## CONCLUSION

In summary, coaches need to be aware of the different developmental levels of their aspiring athletes within any chronological age period, even if that period of time is labeled middle school and high school (most sports programs internationally are designated by age, not school level). The focus of attention for pre-PHV should be on development of foundational and fundamental movement skills, along with development of muscle strength using a variety of implements and bodyweight exercises. For post-PHV athletes, once they can demonstrate proficiency of motor skill development, those skills can be applied to sport-specific settings. Part 2 of this series of articles will apply specific test results and create a developmentally-appropriate strength and conditioning program for each athlete.

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## ABOUT THE AUTHOR

*Rick Howard helped start the National Strength and Conditioning Association (NSCA) Youth Special Interest Group (SIG) and served this year as Immediate Past Chair. In addition, Howard serves on the NSCA Membership Committee and is the NSCA State/Provincial Program Regional Coordinator for the Mid-Atlantic Region. Howard is involved in many pursuits that advance knowledge, skills, and coaching education to help all children enjoy lifelong physical activity and sports participation.*

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