

# Fitness Components of Youth Soccer Players

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# Fitness Components of Youth Soccer Players

## Today's Discussion

- Trainability/critical periods
- Long-term athlete development model (LTAD)
- Youth physical development model (YPD)
- Components of fitness:
  - Strength
  - Power
  - Speed
  - Agility/CODS
  - Endurance



# Trainability of Youth Soccer Players

Trainability in Childhood and Adolescence		
Late Specialization Model	Age	Objective
FUNdamental Stage	Females 6-8 Males 6-9	Learn fundamental movement skills
Learning to Train Stage	Females 8-11 Males 9-12	Learn fundamental soccer skills
Training to Train Stage	Females 11-15 Males 12-16	Build the aerobic base and build strength toward the end of the phase and further develop soccer-specific skills
Training to Compete Stage	Females 15-17 Males 16-18	Optimize fitness preparation and sport, individual and position specific skills as well as performance
Training to Win Stage	Females 17+ Males 18+	Maximize fitness preparation and sport, individual and position specific skills as well as performance
Retention Stage	Competitive Retirement	Retain players for coaching, officials, administration, etc.

Trainability in childhood and adolescence (Hamilton)

Balyi, I, & Hamilton, A. (2004). Long-term athlete development: Trainability in childhood and adolescence. *Olympic Coach*, 16(1), 4-9.



# Sensitive/Critical Periods for Optimal Development of Components of Fitness

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## Trainability

- The responsiveness of children and adolescents at different stages of growth and maturity to a training stimulus
- Related to the concepts of readiness and critical periods

Malina, R. M., & Bouchard, C. & Bar-Or (2004). *Growth, maturation and Physical activity*. Champaign, IL: Human Kinetics

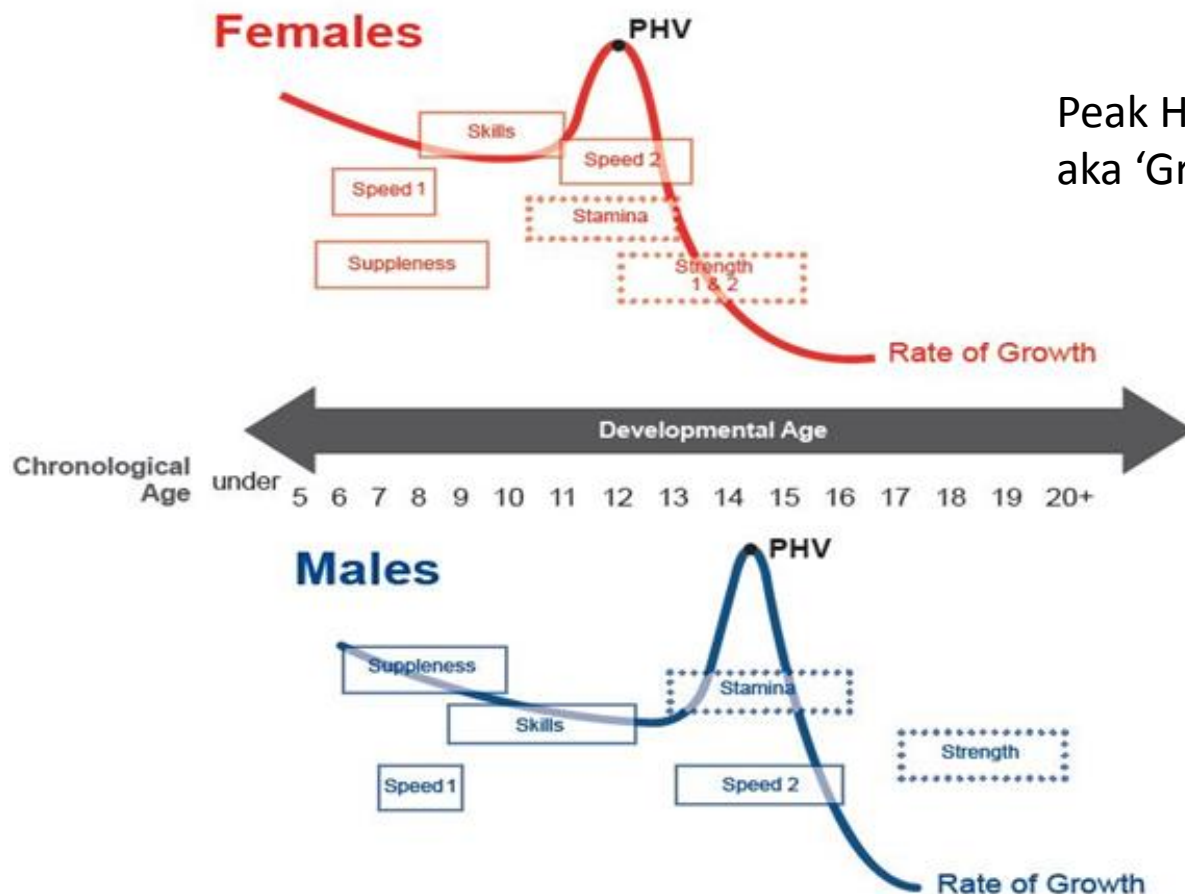
- Sensitive period of accelerated adaptation to training

Balyi, I., Way, R., & Higgs, C. (2013). *Long-term athlete development*. Champaign, IL: Human Kinetics

Viru, A., Loko, J., Harro, M., Volver, A., Laaneots, L., & Viru, M. (1999). Critical periods in the development of performance capacity during childhood and adolescence. *European Journal of Physical Education*, 4(1), 75-119.



# Sensitive Periods for Optimal Development of Components of Fitness (LTAD)



Peak Height Velocity (PHV)  
aka 'Growth spurt'

Balyi, I., & Way, R. (2005). The role of monitoring growth in long-term athlete development. *Canadian Sport for Life*.

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# Sensitive/Critical Periods for Optimal Development of Components of Fitness

## Youth Physical Development Model

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

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

Lloyd, R. S., & Oliver, J. L. (2012). The youth physical development model: A new approach to long-term athletic development. *Strength & Conditioning Journal*, 34(3), 61-72.

# Youth Physical Development Model (YPD) & Trainability

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## What are we training?

- Strength
- Hypertrophy (muscular enlargement from training)
- Power
- Speed
- Agility
- Endurance



# Strength

YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR MALES																								
CHRONOLOGICAL AGE (YEARS)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+				
AGE PERIODS	EARLY CHILDHOOD			MIDDLE CHILDHOOD						ADOLESCENCE							ADULTHOOD							
GROWTH RATE	RAPID GROWTH			↔			STEADY GROWTH			↔			ADOLESCENT SPURT			↔			DECLINE IN GROWTH RATE					
MATURATIONAL STATUS	YEARS PRE-PHV											↔		PHV	↔		YEARS POST-PHV							
TRAINING ADAPTATION	PREDOMINANTLY NEURAL (AGE-RELATED)											↔			COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)									
	Strength			Strength						Strength							Strength							
	Hypertrophy											Hypertrophy			Hypertrophy					Hypertrophy				

YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR FEMALES																						
CHRONOLOGICAL AGE (YEARS)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+		
AGE PERIODS	EARLY CHILDHOOD			MIDDLE CHILDHOOD					ADOLESCENCE							ADULTHOOD						
GROWTH RATE	RAPID GROWTH			↔ STEADY GROWTH ↔					ADOLESCENT SPURT ↔							DECLINE IN GROWTH RATE						
MATURATIONAL STATUS	YEARS PRE-PHV										↔ PHV ↔		YEARS POST-PHV									
TRAINING ADAPTATION	PREDOMINANTLY NEURAL (AGE-RELATED)										↔ COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)											
	Strength			Strength					Strength							Strength						
	Hypertrophy										Hypertrophy		Hypertrophy							Hypertrophy		

- 12-18 months after PHV (PWV) rapid increase in muscle mass
- Hypertrophy (muscular enlargement from training)
- Increase in neuromuscular system in the pre-pubertal years
- Muscular strength the basis for: Running speed, power, CODS & plyometrics
- Muscular strength critical for fundamental movement skills

# Power

YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR MALES																								
CHRONOLOGICAL AGE (YEARS)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+				
AGE PERIODS	EARLY CHILDHOOD			MIDDLE CHILDHOOD							ADOLESCENCE							ADULTHOOD						
GROWTH RATE	RAPID GROWTH			↔			STEADY GROWTH			↔			ADOLESCENT SPURT			↔			DECLINE IN GROWTH RATE					
MATURATIONAL STATUS	YEARS PRE-PHV										←			PHV	→			YEARS POST-PHV						
TRAINING ADAPTATION	PREDOMINANTLY NEURAL (AGE-RELATED)										↔			COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)										
	Power			Power							←			Power			Power							

YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR FEMALES																					
CHRONOLOGICAL AGE (YEARS)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	
AGE PERIODS	EARLY CHILDHOOD			MIDDLE CHILDHOOD					ADOLESCENCE							ADULTHOOD					
GROWTH RATE	RAPID GROWTH			↔ STEADY GROWTH ↔					ADOLESCENT SPURT ↔							DECLINE IN GROWTH RATE					
MATURATIONAL STATUS	YEARS PRE-PHV										← PHV →			YEARS POST-PHV							
TRAINING ADAPTATION	PREDOMINANTLY NEURAL (AGE-RELATED)										↔ COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)										
	Power			Power					Power							Power					

- High levels of power essential to sporting success
- Crucial period for power is at the start of adolescence (increase in muscle power)
- Power is trainable before the onset of adolescence

# Speed

YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR MALES																					
CHRONOLOGICAL AGE (YEARS)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	
AGE PERIODS	EARLY CHILDHOOD			MIDDLE CHILDHOOD							ADOLESCENCE							ADULTHOOD			
GROWTH RATE	RAPID GROWTH ↔			STEADY GROWTH ↔					ADOLESCENT SPURT ↔					DECLINE IN GROWTH RATE							
MATURATIONAL STATUS	YEARS PRE-PHV											PHV		YEARS POST-PHV							
TRAINING ADAPTATION	PREDOMINANTLY NEURAL (AGE-RELATED) ↔											COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)									
PHYSICAL QUALITIES	Speed		Speed					Speed				Speed									

YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR FEMALES																					
CHRONOLOGICAL AGE (YEARS)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	
AGE PERIODS	EARLY CHILDHOOD			MIDDLE CHILDHOOD					ADOLESCENCE							ADULTHOOD					
GROWTH RATE	RAPID GROWTH			↔ STEADY GROWTH ↔					ADOLESCENT SPURT ↔							DECLINE IN GROWTH RATE					
MATURATIONAL STATUS	YEARS PRE-PHV											↔ PHV ↔		YEARS POST-PHV							
TRAINING ADAPTATION	PREDOMINANTLY NEURAL (AGE-RELATED)											↔ COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)									
PHYSICAL QUALITIES	Speed			Speed					Speed							Speed					

- LTAD: **Males** (7-9 yrs & 13-16 yrs) **Females** (6-8 yrs & 11-13 yrs)
- Speed is also influenced by maturation
- Speed is trainable throughout childhood & adolescence
- Childhood (technical competency), adolescence (strength & speed training)

# Agility/CODS

YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR MALES																					
CHRONOLOGICAL AGE (YEARS)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	
AGE PERIODS	EARLY CHILDHOOD			MIDDLE CHILDHOOD							ADOLESCENCE							ADULTHOOD			
GROWTH RATE	RAPID GROWTH ↔			STEADY GROWTH ↔							ADOLESCENT SPURT ↔							DECLINE IN GROWTH RATE			
MATURATIONAL STATUS	YEARS PRE-PHV											PHV		YEARS POST-PHV							
TRAINING ADAPTATION	PREDOMINANTLY NEURAL (AGE-RELATED) ↔											COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)									
	Agility		Agility					Agility					Agility								

YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR FEMALES																						
CHRONOLOGICAL AGE (YEARS)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+		
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GROWTH RATE	RAPID GROWTH			↔ STEADY GROWTH ↔					ADOLESCENT SPURT ↔							↔ DECLINE IN GROWTH RATE						
MATURATIONAL STATUS	YEARS PRE-PHV										↔ PHV ↔		YEARS POST-PHV									
TRAINING ADAPTATION	PREDOMINANTLY NEURAL (AGE-RELATED)										↔ COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)											
	Agility			Agility					Agility							Agility						

- Agility a key physical component for optimal performance
- Change of directions speed (CODS)
- Adolescence an 'opportune' time given the increase in muscle mass
- Cognitive function (response to a stimulus)
- Open vs Closed agility
- Progress to sport-specific movements

# Endurance

YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR MALES																					
CHRONOLOGICAL AGE (YEARS)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	
AGE PERIODS	EARLY CHILDHOOD			MIDDLE CHILDHOOD							ADOLESCENCE							ADULTHOOD			
GROWTH RATE	RAPID GROWTH ↔			STEADY GROWTH ↔							ADOLESCENT SPURT ↔				DECLINE IN GROWTH RATE						
MATURATIONAL STATUS	YEARS PRE-PHV ←										PHV		→ YEARS POST-PHV								
TRAINING ADAPTATION	PREDOMINANTLY NEURAL (AGE-RELATED) ↔										COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)										
	Endurance & MC			Endurance & MC							Endurance & MC				Endurance & MC						

YOUTH PHYSICAL DEVELOPMENT (YPD) MODEL FOR FEMALES																					
CHRONOLOGICAL AGE (YEARS)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21+	
AGE PERIODS	EARLY CHILDHOOD			MIDDLE CHILDHOOD					ADOLESCENCE								ADULTHOOD				
GROWTH RATE	RAPID GROWTH			↔		STEADY GROWTH			↔		ADOLESCENT SPURT				↔		DECLINE IN GROWTH RATE				
MATURATIONAL STATUS	YEARS PRE-PHV					←			PHV		→			YEARS POST-PHV							
TRAINING ADAPTATION	PREDOMINANTLY NEURAL (AGE-RELATED)								↔		COMBINATION OF NEURAL AND HORMONAL (MATURITY-RELATED)										
	Endurance & MC			Endurance & MC					Endurance & MC				Endurance & MC								

# Small-sided Games (SSG) for Soccer Endurance

**Methodology for the main forms of endurance training for soccer and appropriate soccer drills**

Training type	Appropriate training load							Soccer drill examples	
	Intensity			Duration					
	%HR	RPE	Lactate, mmol/L	Total work, min	Rep duration	Reps	Rest	Drill	
Lactate threshold	80–90	Quite hard	3–6	30–60	6–30 min	1–8	<1 min rest	5 × 5	
								6 × 6	
								7 × 7	
								8 × 8	
Vo <sub>2</sub> max	90–95	Stressful	6–12	12–35	3–6 min	4–8	0.5–1 rest ratio	3 × 3	
								4 × 4	
%HR = percent heart rate; RPE = rating of perceived exertion; Reps = repetitions.									
Training loads adapted from Bompa (5).									

Adopted from: Little, T. (2009). Optimizing the use of soccer drills for physiological development. *Strength & Conditioning Journal*, 31(3), 67-74.

# Field Sizes for SSG

Pitch sizes considered small, medium, and large for various soccer drills, reported by Rampinini et al. (25) and Owen et al. (22)			
Soccer drill	Small	Medium	Large
3-a-side	12 × 20 m	15 × 25 m	18 × 30 m
4-a-side	16 × 24 m	20 × 30 m	24 × 36 m
5-a-side	20 × 28 m	25 × 35 m	30 × 42 m
6-a-side	24 × 32 m	30 × 40 m	36 × 48 m
1-a-side possession	5 × 10 m	10 × 15 m	15 × 20 m
2-a-side possession	10 × 15 m	15 × 20 m	20 × 25 m
3-a-side possession	15 × 20 m	20 × 25 m	25 × 30 m
4-a-side possession	20 × 25 m	25 × 30 m	30 × 35 m
5-a-side possession	25 × 30 m	30 × 35 m	35 × 40 m

Adopted from: Little, T. (2009). Optimizing the use of soccer drills for physiological development. *Strength & Conditioning Journal*, 31(3), 67-74.

# Field Size for Soccer Conditioning Games

# of outfield players X (10 x 6 meters)		
Format	Outfield Players	Pitch Size
11 v 11	10	100 x 60 m
10 v 10	9	90 x 54 m
9 v 9	8	80 x 48 m
8 v 8	7	70 x 42 m
7 v 7	6	60 x 36 m
6 v 6	5	50 x 30 m
5 v 5	4	40 x 24 m
4 v 4	3	30 x 18 m
3 v 3	2	20 x 12 m
2 v 2	1	10 x 6
1 v 1	1	10 x 6

Adopted from: Verheijen, R. (2014). *The original guide to football periodisation: Part 1*.  
Amsterdam: World Football Academy BV.

# References

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- Baechle, T.R., & Earle, R.W. (Eds.). (2008). *Essentials of strength training and conditioning*. Champaign, IL : Human Kinetics.
- Balyi, I, & Hamilton, A. (2004). Long-term athlete development: Trainability in childhood and adolescence. *Olympic Coach*, 16(1), 4-9.
- Balyi, I., Way, R., & Higgs, C. (2013). *Long-term athlete development*. Champaign, IL: Human Kinetics.
- Balyi, I., & Way, R. (2005). The role of monitoring growth in long-term athlete development. *Canadian Sport for Life*.
- Bangsbo, J. (2011). *Aerobic and anaerobic training in soccer* (2<sup>nd</sup> ed.). Denmark: Forlaget Storm.
- Behringer, M., Vom Heede, A., Matthews, M., & Mester, J. (2011). Effects of strength training on motor performance skills in children and adolescents: A meta-analysis. *Pediatric Exercise Science*, 23(2), 186-206.
- Little, T. (2009). Optimizing the use of soccer drills for physiological development. *Strength & Conditioning Journal*, 31(3), 67-74.
- Lloyd, R. S., & Oliver, J. L. (2012). The youth physical development model: A new approach to long-term athletic development. *Strength & Conditioning Journal*, 34(3), 61-72.
- Malina, R. M., & Bouchard, C. & Bar-Or (2004). *Growth, maturation and physical activity*. Champaign, IL: Human Kinetics.
- Sheppard, J. M., & Young, W. B. (2006). Agility literature review: Classifications, training and testing. *Journal of Sports Sciences*, 24(9), 919-932.
- Verheijen, R. (2014). *The original guide to football periodisation: Part 1*. Amsterdam: World Football Academy BV.
- Viru, A., Loko, J., Harro, M., Volver, A., Laaneots, L., & Viru, M. (1999). Critical periods in the development of performance capacity during childhood and adolescence. *European Journal of Physical Education*, 4(1), 75-119.

