A CLOSER LOOK AT THE 10 PILLARS OF LTAD—PART 3: THE PARTICIPANT PILLARS OF LTAD FOR STRENGTH AND CONDITIONING PROFESSIONALS

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THE NSCA POSITION STATEMENT ON LONG-TERM ATHLETIC DEVELOPMENT

Long-term athletic development (LTAD) was created as a framework for maximizing athletic performance through each stage of development, from "the playground to the podium" (1). Much of the attention of early models of LTAD focused on elements of training that positively influenced preparation for sporting excellence (2,5). As the models evolved, greater attention was directed toward the developmental pathway and the balance between sporting excellence and lifelong participation in physical activity (1,26). The National Strength and Conditioning Association (NSCA) published a position statement on LTAD, which expanded the framework to include the essentials of strength and conditioning along the developmental continuum (19). The developmental continuum tracks key indicators of the pathway that youth follow throughout childhood and adolescence (13). It is a continuum because children and adolescents do not pass through each phase at the same rate nor at the same time (Pillar 1 states that growth and development are non-linear) (19). Several factors such as age periods (early childhood, middle childhood, adolescence, and adulthood), maturational status (years before puberty, onset of puberty, and years after puberty), and training adaptations (neural and combination of neural and hormonal) are taken together to enable strength and conditioning coaches to create appropriate age and developmental stage strength and conditioning programs (14).

The NSCA LTAD framework informs strength and conditioning coaches, sport coaches, parents, and athletes of the key concepts in strength and conditioning that provide positive experiences for children and adolescents in physical activity. To summarize these important concepts within the position statement, 10 pillars were established to address growth and development, testing and measurement, the importance of developing motor skills and muscle strength, and a focus on the health and wellbeing of the child throughout the LTAD framework. The 10 pillars were later organized into three broad categories (programs, practitioners, and participants) (Figure 1) (27). Each of the articles in this three part-series feature one of the broad categories and explain how the strength and conditioning coach can implement LTAD into strength and conditioning programs for youth athletes at all levels of ability, skill, and maturity.

THE PARTICIPANT PILLARS OF LTAD FOR STRENGTH AND CONDITIONING COACHES

This article will focus on Virgile's Participant Pillars (27) (with reference to the pillar number from the NSCA LTAD Position Statement) (19):

- Enhance physical fitness from early childhood, with a primary focus on motor skill and muscular strength development (Pillar 3).
- Participate in physical conditioning that helps reduce the risk of injury to ensure their on-going participation in LTAD programs (Pillar 6).
- Adopt an early sampling approach (i.e., sample various sports and physical activities) that promotes and enhances a broad range of motor skills (Pillar 4).
- Engage in LTAD programs that promote both physical fitness and psychosocial wellbeing, regardless of age, ability, and aspirations (Pillar 2).

The participant category can be further reorganized into a sentence that reflects the flow of participation in the LTAD framework: all youth athletes should participate in physical conditioning from an early age that focuses on motor skill and muscular strength development by integrating an early sampling approach to develop physical and psychosocial wellbeing. The participant pillars are organized in this format below to clarify how a practitioner may encourage participation in the LTAD framework and suggest practical applications to coaches, parents, and athletes.

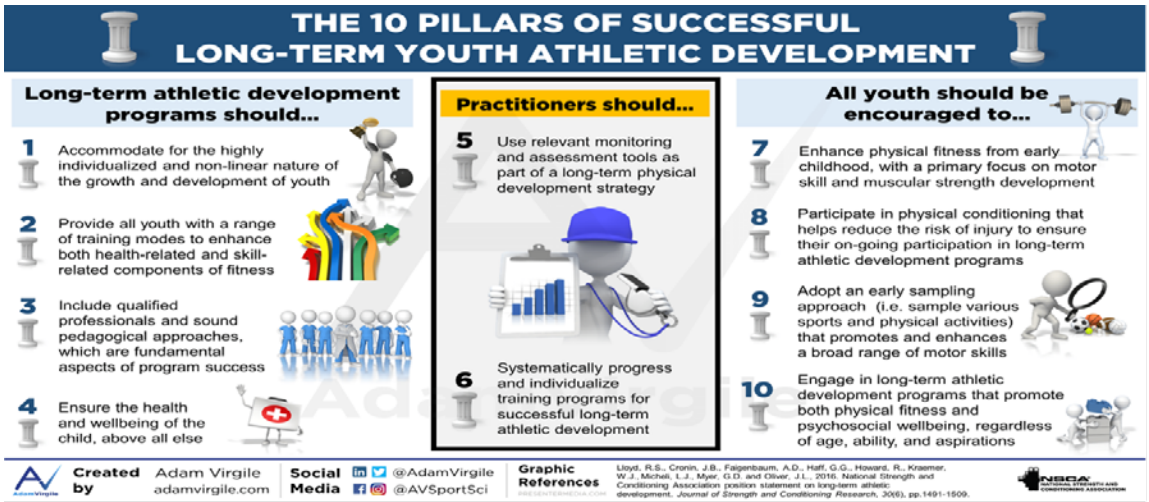

FIGURE 1. PILLARS OF PROGRAMMING, PRACTITIONERS, AND PARTICIPANTS (27)

THE PHYSICAL CONDITIONING PROGRAM PILLAR

Physical conditioning programs are recognized as an integral component of positive youth growth and development (20). The purpose of conditioning is to provide the proper dose of physical exercise necessary to increase overall fitness and physical activity, as well as sport performance (19). This is, of course, context dependent on the demands of a given sport; however, a general conditioning foundation serves the overall goals of the LTAD model. All youth are encouraged to accumulate 60 min of moderate (relative effort rating of 5 – 6 on a scale of 0 – 10) to vigorous (relative effort rating of greater than 6 on a scale of 0 – 10) physical activity, including daily aerobic activity and activities that strengthen bones and build muscle three days each week (6). Misinformation regarding the proper implementation of physical conditioning programs to meet physical activity and athletic performance guidelines may be responsible for such programs leading to undesirable outcomes, such as overtraining, injury, abuse, and even death (20,23). It is important to note that playing sports is not enough to promote high levels of athleticism in youth or address imbalances in performance and physical activity variables such as strength, balance, flexibility, coordination, and fundamental movement skills (18,19). All youth, therefore, whether they participate in sports or other forms of physical activity, will benefit from long-term training programs. The long-term training programs may focus on either the participation or the performance pathway, and each program needs to be designed to meet the needs of each youth athlete. Based on the needs of the youngster, the program should address performance and physical activity variables to promote athleticism and offset growth- and maturity-associated risk factors, such as overweight and obesity, increased risk of injury due to underuse, and increased risk of sport-specific injury (19).

Strength and conditioning coaches need to create inclusive programming for all youth to focus on improving fitness and athleticism. Youth can begin a strength and conditioning program under the direction of a qualified strength and conditioning coach around the same age as they begin structured, organized sports participation (typically between ages 6 – 8 years) (7). When youth begin a resistance training program (or for an individual who has not trained for several months yet), they are considered a "novice." The novice phase lasts for 2 – 3 months. After approximately 2 – 3 months of progress in consistent experience of resistance training, they become classified as "intermediate" for approximately 12 months. A trainee is considered "advanced" once they have attained significant improvements in muscular strength and power, typically after at least 12 months of resistance training experience (7). General strength and conditioning guidelines for youth are summarized in Tables 1 and 2.

TABLE 1. GENERAL YOUTH RESISTANCE TRAINING GUIDELINES FOR STRENGTH (7)

	NOVICE: UNTRAINED AND INEXPERIENCED	INTERMEDIATE	ADVANCED: TRAINED AND EXPERIENCED
Intensity	50 – 70% of 1RM	60 – 80% of 1RM	70 – 85% of 1RM
Volume	1 – 2 sets x 10 – 15 s	2 – 3 sets x 8 – 12 s	3 sets x 6 – 10 s
Exercise choice	Single- and multi-joint	Single- and multi-joint	Single- and multi-joint
Muscle action	ECC and CON	ECC and CON	ECC and CON
Velocity	Moderate	Moderate	Moderate
Frequency (days/week)	2 – 3	2 – 3	3 – 4
Rest Intervals (minutes)	1	1 – 2	2 – 3

Note: 1RM = one repetition maximum; ECC = eccentric; CON = concentric.

TABLE 2. GENERAL YOUTH RESISTANCE TRAINING GUIDELINES FOR POWER (7)

	UNTRAINED AND INEXPERIENCED	INTERMEDIATE	TRAINED AND EXPERIENCED
Intensity	30 – 60% of 1RM	30 – 60% of 1RM	30%-60% of the 1RM
Volume	1 – 2 sets x 3 – 6 reps	2 – 3 sets x 3 – 6 reps	3 sets x 1 – 6 reps
Exercise choice	Multi-joint	Multi-joint	Multi-joint
Muscle action	ECC and CON	ECC and CON	ECC and CON
Velocity	Moderate to fast	Fast	Fast
Frequency (days/week)	2	2 – 3	2 – 3
Rest Intervals (minutes)	1	1 – 2	2 – 3

Note: 1RM = one repetition maximum; VEL = velocity; reps = repetitions; ECC = eccentric; CON = concentric.

Creating physical conditioning programs for youth athletes of all skills and abilities extends beyond sets and repetitions in the weight room. The entirety of the training load needs to be considered (25). As noted by Jayanthi et al., the difference in their initial level (the floor) and their potential level (the ceiling) helps classify youth athletes in one of three categories for training load (16):

1. **Load-Sensitive**: Either skeletally mature or immature and/or have experienced injury or recurrent injury due to load progressions. Lower the ceiling until it can be sustained, then gradually increase to the previous ceiling. If the pattern frequently recurs, consider a less-intense sports pathway.

2. **Load-Naïve**: Skeletally immature and not exposed to higher, intense, and specialized training loads. Total weekly training hours should not exceed the age in years of the child. Smaller, more gradual changes in load are appropriate.

3. **Load-Tolerant**: Skeletally mature and/or previous exposure to higher, intense, and specialized loads. It is possible to train to a higher age-predicted maximum ceiling and be able to tolerate accumulating training load beyond the weekly training hours recommended for their age.

Integrative neuromuscular training (INT) is an approach to load assignment and exercise selection that considers which motor skills have been mastered, which motor skills need improvement, the developmental strength needs, and the inclusion of exercises to reduce the risk of injury (8). The key to successful implementation of INT is a qualified strength and conditioning coach who understands the unique developmental needs of each child (12). When designing the INT program, each participant needs an individualized program based on their experience with strength and conditioning (i.e., training age), not based on their age or grade in school. INT has been used as part of a dynamic warm-up to improve outcomes for youth athletes (8). Movements need to be progressed conservatively using a wide variety of movement patterns in the gym, field, and playground. Among the variables that strength and conditioning coaches need to include in their INT program are movement(s) in the correct plane(s) of motion, stability of the trunk and knee, muscle strength, and motor control and coordination.

The sample program for a youth basketball athlete that considers the integrative components of motor skills and muscle strength along with kinematic and neuromuscular factors is provided for illustrative purposes in Table 3. Strength and conditioning coaches working with youth are encouraged to select movements, exercises, and drills that meet the physical abilities of their athletes.

THE MOTOR SKILL AND MUSCLE STRENGTH PILLAR

Sport coaches are responsible for fostering the technical and tactical elements of sports practice. Too often neglected in the athlete's skill set is motor skill development, which is desperately needed at the youth level (21). Sport coaches and strength and conditioning coaches must consider motor skills development and muscle strength together, as they are inextricably linked. The development of fundamental motor skills includes the following categories: body management, locomotor, and object control. Various skills for each category are provided in Table 4.

Initially, strength and conditioning coaches should have young athletes demonstrate proper athletic stance (9). Once this reference position can be maintained for a 3 – 5-count, youngsters can add single-plane movements that start from the athletic stance. Once single-plane of motion movements are mastered, introduce movements in two planes, and finally, movements in any combination of planes. The goal for the strength and conditioning coach is to teach movement mastery in a variety of planes under a variety of situations with physical, cognitive, and proprioceptive components. The goal for the young athlete is to learn fundamental movement patterns and progress to movement mastery through play, exercise, and sports participation. Incorporating the strength guidelines in Tables 1 and 2 will provide youth athletes with developmentally-appropriate motor skill and muscle strength.

THE ADOPT EARLY SAMPLING PILLAR

As youth sports have shifted emphasis from recreational activities to year-round competitive endeavors, the need to monitor and assess performance has become more important to recognize and mitigate overuse injuries. Early sport specialization, which is defined as year-round training in a single sport at the exclusion of other sport or non-sport activities, is prevalent in 30% of youth athletes (3,28). Overuse injuries are most often cited as a consequence of early sport specialization (3). Table 5 highlights intrinsic and extrinsic factors that can lead to overuse injuries (4).

Early sampling has been suggested as the solution to early sport specialization and concomitant overuse injuries (15,19). Mosher et al., suggested, however, that the negative effects of early sport specialization may not be due to early sport specialization alone (22). The negative consequences of early sport specialization are thought to also include the design, implementation, and management of the early specialization program (22). Therefore, the programs to manage the risks of sport specialization need to focus on best practices to minimize the negative consequences of early specialization. Examples of best practices are shown in Table 6. This is not to say that early sport specialization with attention to the above-noted considerations outweighs early sport sampling. The benefits of participating in a variety of sports and activities, especially during the developmental years, cannot be overemphasized.

TABLE 3. SAMPLE INT BASKETBALL CIRCUIT

EXERCISE	BASKETBALL APPLICABILITY	REASON FOR INCLUSION
Kettlebell Swing	Strength	Reinforce athletic stance and hip mobility
Medicine Ball Partner Pass	Passing	Upper body push with release
Standing Broad Jump	Lower body strength and power	Correlates with other lower body strength measures and upper body strength measures
ViPR© Agility Drill	Agility	Promotes athletic position
Russian Kettlebell Challenge Plank	Core stability	Stability of all body segments
Goblet Squat 6" Box Jump Complex	Lower body strength and power; Proper landing mechanics	Complex training improves jumping ability in youth basketball players
Band Rows	Strength	Upper body push and pull balance
Standing Cable Wood Chop	Rotational strength and mobility	Core rotation
Unilateral Balance Drill	Balance	Balance predicts ankle sprain in youth basketball

TABLE 4. 27 FUNDAMENTAL MOTOR SKILLS DIVIDED INTO 3 CATEGORIES (9)

BODY MANAGEMENT (ABILITY TO BALANCE YOUR BODY WHILE STILL AND IN MOTION)	LOCOMOTOR (ABILITY TO TRANSPORT BODY IN ANY DIRECTION)	OBJECT CONTROL (ABILITY TO CONTROL IMPLEMENTS)
Balance (dynamic)	Crawling	Bouncing
Balance (static)	Dodging	Catching
Bending	Galloping	Dribbling (feet/hands)
Climbing	Hopping	Kicking
Landing	Jumping (distance/height)	Striking
Rolling	Leaping	Throwing
Stopping	Running	
Stretching	Skipping	
Swinging	Swimming	
Turning	Walking	
Twisting		

TABLE 5. PREDISPOSING FACTORS AND OVERUSE INJURIES (4)

INTRINSIC FACTORS	EXTRINSIC FACTORS
Anatomic malalignment	Improper training methods
Prior injury	Poor technique
Poor conditioning	Improper surface for practice and competition
Growth	Excessive pressure from peers, coaches, and parents
Menstrual dysfunction	Inappropriate equipment

TABLE 6. BEST PRACTICES TO MANAGE THE RISKS OF EARLY SPORT SPECIALIZATION (ADAPTED FROM 22)

ESTABLISH AN ENVIRONMENT THAT PROMOTES POSITIVE HEALTH AND REDUCES NEGATIVE HEALTH CONSEQUENCES	MONITOR AND EVALUATE ATHLETES	PROVIDE PSYCHOLOGICAL SKILLS TRAINING
• Create an environment that values the holistic development of each athlete (technical, tactical, physical, psychological, social health, and performance) • Implement an integrated approach for personal, social, and physical youth development • Focus on a sports-life balance, providing opportunities for other priorities, including social time with family and friends, academic work, and enjoying other activities • Use INT to develop a broad range of skills, including fundamental motor skills • Create autonomy-supported, skill mastery-oriented climates to reduce loss of motivation and enjoyment	• Monitor and Evaluate: » Wellness » Growth and maturation » Training load, including frequency, volume, and intensity of training, alongside adequate rest and recovery » Physical development » Injury prevalence » Psychosocial factors	• Assist athletes in acquiring psychological strategies for coping, goal setting, and managing multiple demands • Commit to the psychological development of resilient and adaptable athletes characterized by mental capability and robustness, high self-regulation, and enduring personal excellence qualities • Create open lines of communication for athletes to communicate honestly about how they are feeling

THE PROMOTE FITNESS AND PSYCHOSOCIAL WELLBEING PILLAR

The importance of meeting all youth where they are to help them on their physical conditioning journey cannot be overstated. Integral to the physical development of all aspiring youth athletes is the balance of their physical and psychosocial wellbeing. The NSCA Position Statement on LTAD suggests that practitioners pay special attention to factors such as dietary behaviors, educational stress, sleep patterns, psychosocial health, unrealistic external pressures from their circle of influence (including coaches, friends, and parents), and matching young athletes' developmental level and their participation in performance versus participation models (19). The evidence suggests that for sports to contribute to positive youth development for all children and adolescents, sport needs to be more inclusive of youth of all abilities, intently develop a wide range of fitness components, and mindfully nurture psychosocial attributes to complement the physical attributes (20,24). Psychosocial considerations for practitioners are presented in Table 7.

CONCLUSION

This three-part series provides strength and conditioning coaches who work with youth a resource for integrating the LTAD framework into youth sports and strength and conditioning. Notably, improving the health and wellbeing as the central tenet of LTAD is evidenced within each pillar. The LTAD framework fits within the overall construct of wellness (Table 8). Focusing on the dimensions of wellness can support the 10 pillars of LTAD and vice versa. A review of all 10 pillars along with recommendations for strength and conditioning coaches (Table 9) complement the programming recommendations and suggestions provided in this three-part series on LTAD.

TABLE 7. PSYCHOSOCIAL CONSIDERATIONS FOR PRACTITIONERS (24)

SPORTS PARTICIPATION	
Evidence-based practices to maximize psychosocial benefits	• Consider individually focused factors for sport-related coping: » Personality » Motivation » Cognitive evaluation • Use of task-oriented coping (problem focused) strategies, such as effort expenditure, thought control, relaxation, and mental imagery
Manage risk of burnout	• Be aware of psychosocial factors related to burnout: » Chronic emotional and interpersonal stressors » Stress of intense training and competition » Exhaustion » Negative perceptions of ability or performance leading to reduced motivation
Promote optimism and hardiness	• Promote sense of control • Increase athlete confidence • Increase athlete's ability to perceive and react to stressful circumstances • Increase athlete's ability to: » View their environment as controllable » Perceive themselves as capable » Stay committed under adverse conditions » Consider problems as natural challenges
Promote developmental assets	• Support • Empowerment • Positive identity • Connection to others (inclusion, awareness, and growth fostering relationships) (17)
Create an environment that supports diversity, equity, and inclusion (DEI)	• Promote autonomy, wellbeing, positive body image, empathy, and peer support • Focus on creating an inclusive environment form the very beginning • Foster open communication • Create shared strategies for inappropriate behavior and managing conflict • Include educational sessions about DEI and cultural awareness
Promote coping	• Introduce and promote effective coping strategies through conversation and instruction • Provide perspective • Share experiences • Periodize and structure potentially stressful experiences

TABLE 8. HETTLER'S SIX DIMENSIONS OF THE WELLNESS WHEEL (10)

WELLNESS WHEEL DIMENSION	CHARACTERISTICS
Emotional	• For example: feelings, emotions, and reactions • How do we deal with the emotional challenges we face?
Intellectual	• Desire to learn, mindset (e.g., curiosity) • Are we open to new ideas and experiences?
Occupational	• Can be thought of as school time for youth • How is school life and play time balanced?
Physical	• For example: physical activity, nutrition, and healthy habits • Do you take charge of your own physical health?
Social	• For example: relationships, our role in society, and respect • How do we get along with others and they with us?
Spiritual	• For example: meaning, values, tolerance of the beliefs of others • Have we discovered our meaning/purpose in life?

TABLE 9. THE 10 PILLARS OF LTAD FOR COACHES (11,19)

PILLAR	RECOMMENDATIONS FOR STRENGTH AND CONDITIONING PROFESSIONALS
LTAD pathways should accommodate for the highly individualized and non-linear nature of the growth and development of youth.	• Apply sound understanding of pediatric exercise science to: » Prescribe training programs commensurate with the needs and abilities of the individual » Distinguish between training-induced and growth-related adaptations (positive or negative) in performance » Understand how growth, maturation, and training interact
Youth of all ages, abilities, and aspirations should engage in LTAD programs that promote both physical fitness and psychosocial wellbeing.	• Appreciate the potential impact that other lifestyle factors (nutrition, rest and recovery, psychosocial health, and external pressures) have on physical fitness and physical activity • Prescribe exercise intervention for muscle strength, motor skills, and athleticism • Promote participation pathways for all youth to be able to transition between developmental pathways
All youth should be encouraged to enhance physical fitness from early childhood, with a primary focus on motor skill and muscular strength development.	• Encourage an early start to free play and deliberate play (birth to 5 – 6 years) and developmentally appropriate strength and conditioning (starting at 6 or 7 years old) • View coordination and muscle strength as synergistic components of motor skill performance • Prioritize neuromuscular training as part of the multidimensional strength and conditioning program
LTAD pathways should encourage an early sampling approach for youth that promotes and enhances a broad range of motor skills.	• Promote sampling, an approach that encourages youth to be introduced to a variety of sports and activities and to participate in several positions within a given sport • Focus on the quality of practice rather than on its quantity • Refrain from early specialization, the year-round intensive training within a single sport or physical activity to the exclusion of other sports and activities

TABLE 9. THE 10 PILLARS OF LTAD FOR COACHES (11,19) (CONTINUED)

PILLAR	RECOMMENDATIONS FOR STRENGTH AND CONDITIONING PROFESSIONALS
The health and wellbeing of the child should always be the central tenet of LTAD.	• Create a pleasurable and fulfilling culture of positive experiences in sport and physical activity, that promote wellbeing by emphasizing: » A growth mindset » Self-determined motivation » Perceived competence » Confidence » Resilience • Focus on the long-term view of developing athleticism that includes chronic and sustainable adaptations • Do not use physical activity as punishment or allow forced physical exertion
Youth should participate in physical conditioning that helps reduce the risk of injury to ensure their on-going participation in LTAD programs.	• Provide a well-rounded strength and conditioning program that includes resistance training, motor skill and balance training, speed and agility training, and appropriate rest • Be sure that the strength and conditioning program is developmentally appropriate and suitably prepares youth for the demands of sport and physical activity • Address underuse by providing a long-term program for athleticism for nonathletic youth
LTAD programs should provide all youth with a range of training modes to enhance both health- and skill-related components of fitness.	• Recognize that both children and adolescents can make worthwhile improvements in all components of fitness irrespective of their stage of development
Practitioners should use relevant monitoring and assessment tools as part of a LTAD strategy.	• Collect quarterly measures of stature, limb length, and body mass to monitor growth and maturation • Measure both the product (e.g., jump distance) and the process (e.g., how technically proficient the jumps are) when assessing physical capacities in youth • Assess psychosocial wellbeing in youth with a validated instrument for children and youth
Practitioners working with youth should systematically progress and individualize training programs for successful LTAD.	• Adopt a progressive, individualized, and integrated approach to the programming of strength and conditioning activities • Youth training programs should be dictated by the needs of the individual, the individual's technical competency, and the requirements of the relevant sports or activities • Periodization represents the theoretical framework and involves sequential blocks of training to maximize the overall training response, and considers: » The accommodation of influential factors such as time and facilities available for training » The pressures of academic work » The need for socializing with family and friends » Rest and recovery within and between sessions and as mandatory blocks within the periodization model » The scheduling of training and competitions » The influence of growth and maturation for each youth
Qualified professionals and sound pedagogical approaches are fundamental to the success of LTAD programs.	• Strength and conditioning coaches need a solid understanding of: » Pediatric exercise science » Training principles » Pedagogy » Developmental appropriateness » Coaching skills » Cueing » Providing motivation » Cultivating an environment that promotes intrinsic motivation and enjoyment

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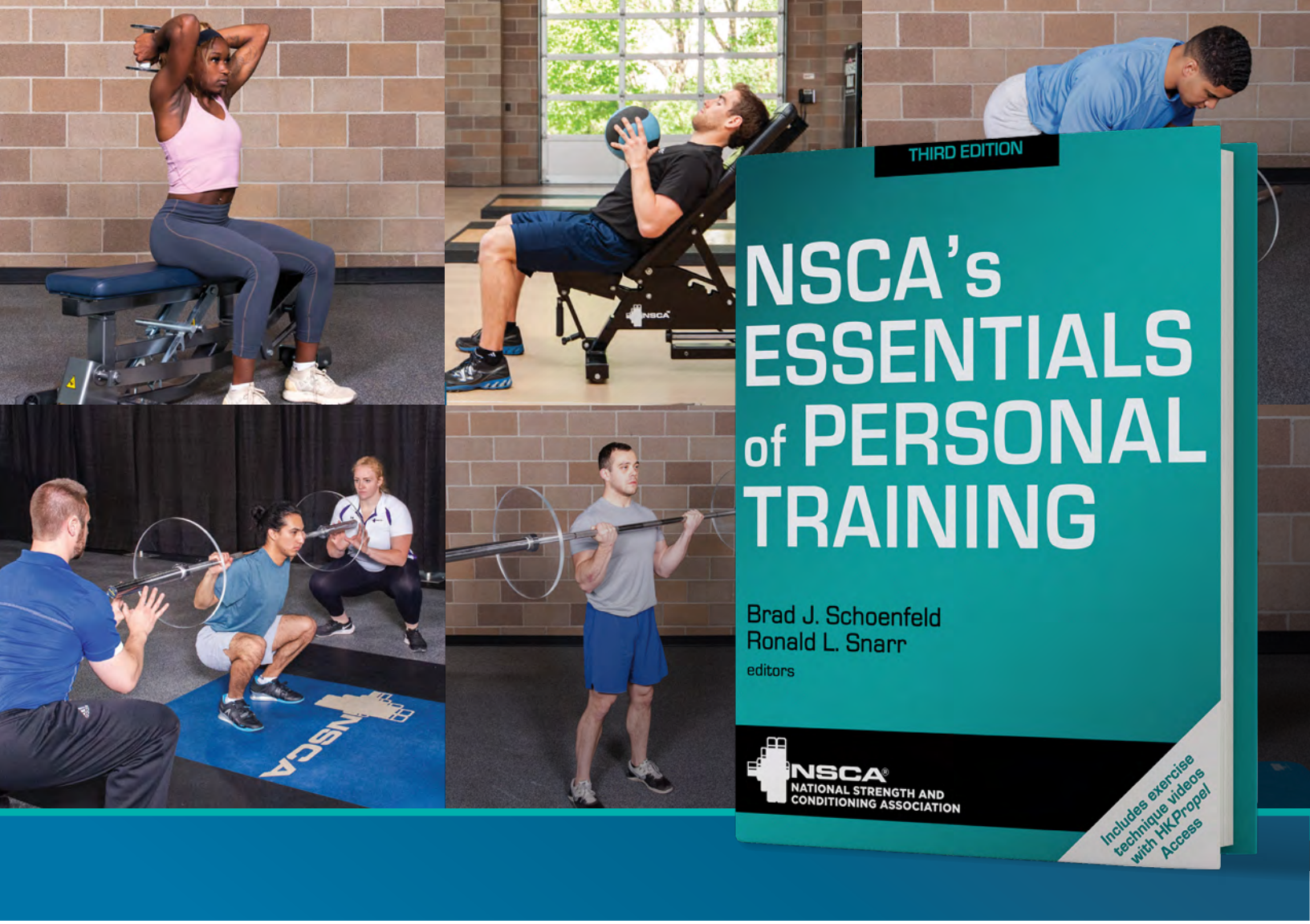

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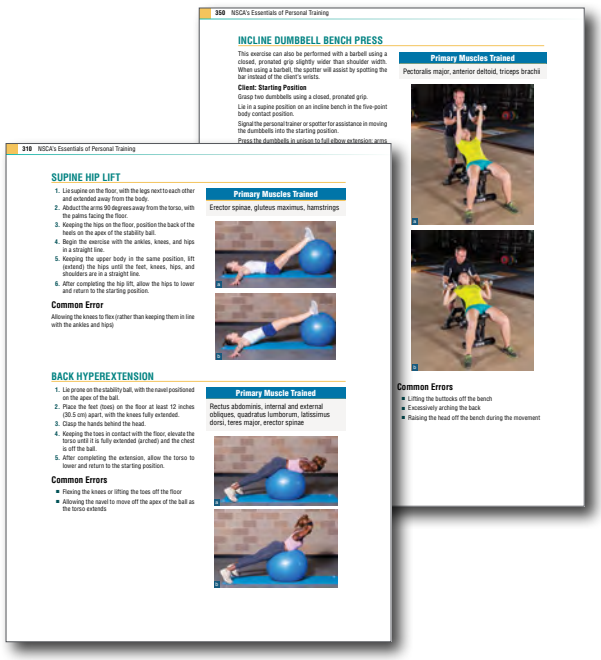

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