

A One-Year Periodized Training Program for the Advanced High Jumper

I. Introduction

One of the oldest and most technically challenging events of track and field is the high jump. The sport of high jumping dates back to the ancient Olympics, and while the styles and techniques used by jumpers have evolved considerably, the relatively simple objective of the event, to clear the bar at progressively increasing heights, has remained unchanged. Prior to the 1960s, the major methods used by high jumpers to clear the bar included the scissor jump, the straddle, the eastern roll, and the western roll. In ^{1972-?} (1968) Dick Fosbury won the Olympic games using a new style of jump, the "Fosbury-Flop (Fidler, 1992)". This eccentric jumping style utilizes a back-layout technique performed at a right angle to the bar, and it is now the predominate jumping style used by competitive high jumpers (Bowerman & Freeman, 1991).

The standard used to measure success in the high jump is the maximum bar height that an athlete is able to successfully clear. Although psychological factors such as self-confidence and concentration play a role, the two performance factors that determine this height are the take-off angle and the ability of the athlete to project his/her center of gravity (COG) from the ground. The issue of take-off angle is a matter of technique best improved by drills specifically designed by an individual knowledgeable in high jump technique (Schweigert, 2000); for the purposes of this paper, a training program will be described aimed at improving the projection of the COG.] good specific goal

The height of projection of the COG is dependent on the vertical velocity the athlete is able to obtain at the end of the take-off phase of the jump (Dapena, 1992). Increases in take-off velocity as small as 0.1 m/s can result in a 3-4 cm increase in COG projection height. The two factors that determine the take-off vertical velocity are the horizontal velocity of the approach and the ability of the athlete to convert the horizontal velocity to vertical velocity (Dursenev, 1991). Within the limits that the athlete is able to control the horizontal speed and effectively convert it to vertical velocity, a faster horizontal speed can lead to a higher jump (Schweigert, 1992).

The conversion of horizontal to vertical velocity with minimal speed loss requires great eccentric strength of the extensor leg muscles (Schweigert, 2000). During the first part of the take-off, the amortization phase, the knee extensor muscles attempt to prevent the knee from excessive flexion, but are unable to do so due to the forward momentum of the jumper. The kinetic energy built up in the approach produces a myotatic stretch reflex in the extensor muscles of the take-off leg leading to an eccentric muscle contraction. This is then quickly followed by an explosive concentric contraction and the release of energy during the extension phase of the take-off (Dapena, 1992; Schweigert, 2000). Research has shown that the involvement of the concentric contractions during the extension phase are approximately one third less active than the involvement of the eccentric contractions during the amortization phase (Dursenev, 1991). This research indicates the importance for high jumpers to develop eccentric strength in the leg extensor muscles. The eccentric strength will help to prevent extreme flexion of the leg during take-off and decrease the amount of speed lost in converting horizontal speed to vertical velocity. Specific exercises to increase eccentric strength include: (partial and full range squats), power cleans and snatches, hang cleans and snatches, push jerks, hurdle jumps, depth jumps, and depth landings (Schweigert, 2000).

An additional performance component that should be addressed in a training program for an advanced high jumper is power. Depending on the style of flop the jumper uses (speed flop which utilizes a faster approach vs. power flop which relies on strength), the time a jumper spends on the ground during take off ranges from 0.13 seconds to 0.21 seconds (Bowerman & Freeman, 1991). During this period the jumper must generate a maximal amount of strength at a maximal speed of contraction. The ability to generate strength quickly during the concentric contraction is the final determinant of the vertical velocity achieved at take-off (Schweigert, 1992). Rate of force development exercises, such as plyometrics and explosive/speed-strength resistance training, are considered to be crucial additions to training programs designed for competitive sports in which the time available to develop force is less than 0.3 seconds

(Zatsiorsky, 1995); both plyometrics and speed-strength resistance training will be utilized in this training program.

II. Training Program

This is a one-year progressive training program designed for an 18-year-old high jumper preparing to enter her first year competing in outdoor track and field at the Division 1 collegiate level. In high school this athlete competed in three sports (volleyball, basketball, and track), thus she has never done extensive, year-round training for the high jump. This athlete jumps in the traditional Fosbury Flop style using the power flop approach. Jumpers using this style tend to have a slower approach (7-8 m/sec) and spend an average of 0.17-0.21 seconds on the ground during take-off (Bowermann & Freeman, 1991). This style of jumping necessitates great strength development to generate the explosive force used for the jump. (The primary goal of this training program, based on the needs analysis of the sport and the review of literature, is to increase the eccentric strength and explosive power of the leg muscles.) *Excellent specificity*

This program will describe distinct exercises/drills and training goals for five phases of training throughout the year: preseason (June - November), early training season (December-February), competitive season (March-April), late season/peak (early May), and off-season/active rest (2-4 weeks following the last competition). The training program will generally follow the classic periodization model (Kraemer & Häkkinen, 2002) with the aim to peak at the Big 12 Conference Outdoor-Track Championships held the third week in May. It is a progressive training program in that the amount of resistance lifted by the athlete is progressively increased to match strength gains; in addition, the intensity and volume are progressed every 1-2 weeks of each phase. It is recommended that the athlete take a week of active recovery every 8-12 weeks of the program described to allow her body the necessary recovery from the training and to reduce/eliminate the possibility of overtraining. The coach should coordinate the periods of active recovery to coincide with the training she is doing for other aspects of the event and also with the competition schedule. A brief overview of the

training program is first presented followed by a specific outline of exercises and progressions for each of the phases.

Preseason: June-November (24 weeks)

The goal of the preseason period is for the athlete to develop a strong conditioning base to prepare the athlete for the quality training to be done later in the season. Proper lifting technique will be taught during this phase with special attention given to the Olympic style lifts.

I. General Base Training (Weeks 1-6):

a. **Resistance Training:** The athlete will utilize a basic weight-training circuit regimen for the major muscle groups during this phase. The circuit will be done three times per week and include 1-3 sets of 12-15 reps at 75-80% of 1RM with 30 seconds to 1 minute rest between exercises. The following exercises will be included in the circuit and done in the order listed: power snatches, power cleans, push jerks, squats (full range, partial range, and single leg), hamstring curls, leg extensions, heel raises, calf raises, bench press, shoulder press, tricep extensions, bicep curls, rows, and pull-ups. In addition core training for the abdominals (50 crunches, 50 side crunches, 50 leg raises, and 50 twists) and back (25 reps alternating each session between roman chair back extensions, 'good mornings,' and the lower back machine) will be include in each circuit training session. To minimize the risk of injury, it is important that the athlete complete the circuit in the order listed. A large amount of motor skill and coordination is required to perform the Olympic style lifts. If the athlete attempts to complete these exercises when physically or mentally fatigued, poor technique is likely to result, which could easily lead to injury. The upper body and core exercises are included in the training program to help develop the postural support necessary to maintain the correct body alignment and arm movement throughout the event (Kraemer & Häkkinen, 2002). *good*

II. Hypertrophy (Weeks 7-24)

a. **Resistance Training:** The athlete will continue to perform the same weight lifting exercises done in the base training, but instead of doing them in a circuit, all of the sets for a

given exercise will be completed before starting the next exercise. This resistance training program will be done three times per week and include 3-5 sets of 8-10 reps at 80-85% 1RM.

b. Plyometrics: Plyometrics are exercises designed to increase the rate of maximal force development; the exercises consist of an eccentric muscle contraction rapidly followed by a concentric contraction (Kraemer & Häkkinen, 2002). This type of training is ideal for the high jump in which the athlete must generate a maximal amount of force at a maximal speed of contraction. The general strength base developed during the base training serves as a necessary foundation to the incorporation of plyometrics into the training program (Rogers, 2000). Jumping circuits consisting of jumping, bounding, and skipping drills will be incorporated twice a week during this phase. The circuits consist of a total of 250-525 jumps with 2-minute rest periods between drills, the drills progressively increasing in difficulty throughout the phase. The progression in volume and intensity of the plyometric drills are similar to those recommended by Bob Meyers (1990) for inclusion in training programs for advanced high jumpers. Plyometric exercises have similar fatigue effects on the body as resistance training (Kraemer & Häkkinen, 2002), thus the plyometric exercises will be done on non-resistance training days (Tuesday and Thursday).

Early Training Season: December-February (12 weeks)

The primary goal of the early training season is to increase the athlete's maximum strength as well as to begin explosive, sport-specific training.

a. Resistance Training: The athlete will continue lifting three times per week (MWF); Monday and Friday's training sessions will be aimed at increasing maximum strength in the leg muscles and the Wednesday session will be focused on increasing explosive strength utilizing speed-strength training. Although this deviates from the traditional periodized training program, it is essential that the high jumper begin to develop explosive power to be prepared for early season competitions. Thus, the non-linear periodization program, designed to vary intensity throughout the training week so that the body receives the necessary stimulus for both strength

and power gains, will be more beneficial in this phase. During the Monday and Friday sessions the athlete will also do an upper body and core maintenance routine. The maintenance routine will consist of 2 sets of 10 reps at 75% of 1RM with 30 seconds rest between exercises/sets for the upper body (using the same exercises as in the hypertrophy phase), 4 sets of 50 reps for the abdominals with the athlete choosing the type of crunch (i.e. forward, side, twist, leg lifts, bridge, crossed leg, one-leg tuck), and 25 reps of back exercises with the athlete alternating each session between the roman chair back extensions, 'good mornings', and the lower back machine.

- **Maximum Strength Training Sessions** (Monday and Friday)

The goal of the maximum strength training sessions is to increase the athlete's ability to develop maximal force. The athlete will be lifting moderate-high intensity weights (85-95% 1RM) with a moderate-low volume (3-4 sets of 4-8 reps) and a rest period of 2-3 minutes between sets. The following lower body exercises will be included: squats (full range, partial range, and (single leg)), lunges, hamstring curls, leg extensions, heel raises, calf raises.

- **Speed-Strength Training Sessions** (Wednesday)

The goal of the speed-strength training sessions is to teach the athlete to generate as much force as possible in a short amount of time. The athlete will perform 3-4 sets of 3-6 reps at 30-60% 1RM with maximal exertion/lifting velocity. Rest periods of 3-4" between exercises/sets will be given in order to allow adequate recovery. The athlete will perform the following exercises during the power-training sessions in the order listed: power snatches, power cleans, push jerks, single-leg squats, partial squats, and full squats. The power snatches and power cleans will be alternated with hang snatches and hang cleans every other session.

b. **Plyometrics:** The plyometric drills will continue to increase in difficulty (increased obstacle heights) and specificity (unilateral jumps to train for the one-legged take-off) throughout this phase. As the intensity increases, the volume of jumps will decrease (100-175); the athlete

will continue to do the exercises twice per week (Tuesday and Thursday) for the first 8 weeks of this phase and will then decrease to only one plyometric session per week (Tuesday).

Competitive Season: March-April (8 weeks)

a. **Resistance Training:** The primary goal of the competitive season is to increase the athlete's ability to generate force quickly, thus the athlete will increase the speed-strength training sessions to twice per week (Monday and Friday) and the maximal strength resistance training will be reduced to once per week (Wednesday). The maintenance upper body/core training routine will continue to be done once a week following the maximal strength sessions.

- **Maximum Strength Training Sessions:** (Wednesday)

The goal of the maximum strength resistance training sessions is to maintain the strength gained during the maximal strength phase by incorporating a very high intensity (95-100% 1RM), low volume (3-5 sets of 1-3 reps with 3-4 minute rest between exercises/sets) resistance training session one time per week. The athlete will continue to do the same lower body exercises as done in the previous phase. The volume of exercise the athlete does will progressively decrease during this phase with the intensity remaining high.

- **Speed Strength Training Sessions:** (Monday and Friday)

The same exercises and progression of intensity began during the early training season will be progressed upon during this phase (3-4 sets, 3-6 reps, 50-60% 1RM, 3-4"rest).

b. **Plyometrics:** The plyometric drills during this phase will be of a very high intensity and specificity and a low volume (85-100 jumps, once per week). The plyometric drills will be done early in the week (Tuesday) in order to allow sufficient time to recover before a weekend competition.

Late Season/Peak: Early May (2-3 weeks)

a. **Resistance Training:** To keep the athlete explosive and ready for competition the athlete will decrease to only two resistance training sessions per week (Monday and Wednesday). Both of these sessions will be speed-strength/explosive training sessions of a

good - progression

very high intensity and low volume with long recovery periods (3 sets, 3-6 reps, 80-85% 1RM, 4-minute rest). The heavy strength training program and maintenance upper body/core training program will be discontinued for this period in order to best utilize the training time focused on the specific explosive needs of the event.

b. **Plyometrics:** Only jumps very specific to the high jump will be incorporated during the peak phase (jumps onto box, hurdle hops, and depth jumps all done unilaterally). The drills will be of a high intensity and a low volume (50-75 jumps) with full recovery between each drill. The athlete will do only one plyometric training session per week during the peak phase (Tuesday).

Off-Season/Active Rest: 2-4 weeks following the last competition

The goal of this period is to allow time for the athlete to recover from the previous year of training. During this phase the athlete will maintain overall fitness doing her choice of enjoyable physical activities. The goal is for the athlete to return following this phase injury free and motivated to begin training again.

III. Conclusion

The goal of this program is to increase eccentric leg strength and explosive power in an advanced high jumper. This is accomplished through a one-year, periodized, progressive weight training and plyometric program. It is recognized that improvement of eccentric leg strength and explosive power is only one aspect needed in training for the high jump. Additional programs designed for increasing approach speed and improving jumping style/technical skills should be incorporated along with this program to provide sufficient training for the high jump.

Resistance Training Program

I. Preseason: June-November

General Base Training: Weeks 1-6 (Monday, Wednesday, Friday)

Circuit (Done in order listed): Power snatches, power cleans, push jerks, squats (full range, partial range, and single leg), hamstring curls, leg extensions, heel raises, calf raises, bench press, shoulder press, tricep extensions, bicep curls, rows, and pull-ups, abdominals (50 crunches, 50 side crunches, 50 leg raises, and 50 twists) and back extensions (25 reps alternating each session between roman chair, lower back machine, and 'good mornings')

Week 1: 1 set, 12-15 reps, 75% 1RM, 1" rest; of the squat exercises include only partial range squats.

Week 2: 2 sets, 12-15 reps, 75% 1RM, 1" rest; include partial and full range squats.

Week 3: 2 sets, 12-15 reps, 80% 1RM, 30-sec rest; include partial and full range squats.

Week 4-6: 3 sets, 12-15 reps, 80% 1RM 30-sec rest; include full range, partial range, and single-leg squats.

Hypertrophy: Weeks 7-24 (Monday, Wednesday, Friday)

The athlete will continue to perform the same weight lifting exercises done in the base training, but instead of doing them in a circuit, all of the sets for a given exercise will be completed before starting the next exercise.

Week 7-8: 3 sets, 8-10 reps, 80% 1RM, 60-sec rest

Weeks 16-19: 5 sets, 8-10 reps, 85% 1RM, 40-sec rest

Week 9-12: 4 sets, 8-10 reps, 80% 1RM, 50-sec rest

Weeks 20-24: 5 sets, 8-10 reps, 85% 1RM, 30-sec rest

Weeks 13-15: 4 sets, 8-10 reps, 85% 1RM 40-sec rest

II. Early Training Season: December-February

A. Resistance Training:

• Maximum Strength Training Sessions (Monday and Friday):

The following exercises will be done during these sessions: squats (full range, partial range, and single leg), lunges, hamstring curls, leg extensions, heel raises, and calf raises.

Week 1-3: 3 sets, 4-8 reps, 85% 1RM, 2" rest

Week 7-9: 3 sets, 4-8 reps, 95% 1RM, 3" rest

Week 4-6: 4 sets, 4-8 reps, 90% 1RM, 2" rest

Week 10-12: 4 sets, 4-8 reps, 95% 1RM, 3" rest

• Speed-Strength Training Sessions (Wednesday)

The athlete will perform the following exercises during the power-training session in the order listed: power snatches, power cleans, push jerks, single-leg squats, full squats, and partial squats. The power snatches and power cleans will be alternated with hang snatches and hang cleans every other session.

Weeks 1-3: 3 sets, 3-6 reps, 30% 1RM, 4" rest

Weeks 7-9: 4 sets, 3-6 reps, 40% 1RM, 4" rest

Weeks 4-6: 3 sets, 3-6 reps, 40% 1RM, 4" rest

Weeks 10-12: 4 sets, 3-6 reps, 50% 1RM, 4" rest

• Maintenance Upper Body/Core Routine (Monday and Friday after Max Strength session)

Weeks 1-12:

Upper Body: 2 sets of 10 reps at 75% of 1RM with 30 seconds rest between exercises/sets.

Core: Abdominals: 4 sets/50 reps, athlete chooses type of crunch (forward, side, twist, leg lifts, bridge, crossed leg, tuck); Back extensions: 25 reps alternating roman chair, lower back machine, and 'good mornings'.

III. Competitive Season: March-April

The maintenance upper body/core training routine will continue to be done once a week following the maximal strength sessions.

• Maximal Strength Training Sessions: Wednesday

Weeks 1-2: 5 sets, 2-3 reps, 95% 1RM, 3" rest

Weeks 5-6: 4 sets, 1-2 reps, 100% 1RM, 4" rest

Weeks 3-4: 5 sets, 2-3 reps, 95% 1RM, 3" rest

Weeks 6-8: 3 sets, 1-2 reps, 100% 1RM, 4" rest

• Speed Strength Training Sessions: Monday and Friday (same exercises)

Weeks 1-2: 3 sets, 3-6 reps, 50% 1RM, 3" rest

Weeks 4-6: 3 sets, 3-6 reps, 60% 1RM, 3" rest

Weeks 2-4: 3 sets, 3-6 reps, 60% 1RM, 4" rest.

Weeks 6-8: 4 sets, 3-6 reps, 60% 1RM, 3" rest

IV. Late Season/Peak: Early May

The heavy strength training and maintenance upper body/core routine will be discontinued during this period.

• Speed-Strength Training Session: Monday and Wednesday

Exercises (Done in order listed): Power cleans, power snatches, push jerks, single-leg squats, full squats, partial squats (alternate power snatches/cleans with hang snatches/cleans every other session).

3 sets, 3-6 reps, 80-85% 1RM, 4" rest between exercises/sets.

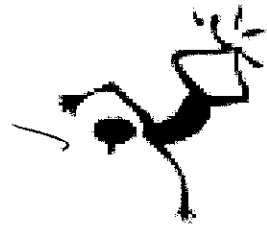
V. Active Rest: 2-4 weeks following the last competition

The athlete can choose whatever type of training she finds enjoyable... focus on recovery and having fun!

- ★ It is recommended that the athlete take a week of active recovery every 8-12 weeks of the program described to allow her body the necessary recovery from the training and to reduce/eliminate the possibility of overtraining. The coach should coordinate the periods of active recovery to coincide with the training she is doing for other aspects of the event and also with the competition schedule.

Plyometric Training Program

PreSeason (Tuesday and Thursday)			
Week	Exercise	Sets x Reps	Rest
1-6	NO PLYOMETRICS		
7-8	Bounding	2 x 50 m	2"
	High Skips	2 x 50 m	
	Jump Rope: Both Legs	2 x 25	
9-10	Jump Rope: Right Leg	2 x 25	2"
	Jump Rope: Left Leg	2 x 25	
11-14	Same Circuit as Week 7-8	3 sets of all drills	2"
	Box Jumps	3 x 10	
	Forward/Backward Over Cone	3 x 20	
	Lateral Jumps Over Cone	3 x 20	
	Double Leg Hops	2 x 25 m	
	Power Step-Ups onto Box	3 x 20	
	Same Circuit as Week 11-14, add Single Leg Hops		
15-18	Same Circuit as Week 9-10; Change bounds to speed bounds	2 x 20 m each leg	2"
19-20	Box Jumps	3 sets of all drills	2"
	Lateral Jumps onto Box	3 x 10	
21-24	Single Leg Hops	4 x 20 m each leg	
	Power Bounds	2 x 50 m	
	Power Step-Ups onto Box	3 x 25	



Early Training Season			
Week	Exercise	Sets x Reps	Rest
1-4	Forward Box Jump (Increase box height)	3 x 10	2"
	Double Leg Hurdle Hops	3 x 10	
	Depth Landings	2 x 10	
	Double-Leg Takeoff Jumps	3 x 10	
5-8	Depth Jumps with Rebound	2 x 10	2"
	Single Leg High Jumps	2 x 10 each leg	
	Hurdle Jump with Rebound	2 x 10	
	Forward Box Jump	3 x 10	
9-12	Single Leg Depth Jump	2 x 10 each leg	2"
	Single Leg Hurdle Hop	2 x 10 each leg	
	Hurdle Jump with Rebound	2 x 10	
	Depth Jumps with Rebound	2 x 10	
	Single Leg High Jumps	2 x 10 each leg	

Competitive Season			
Week	Exercise	Sets x Reps	Rest
1-4	Forward Box Jump (Increase box height)	2 x 10	2.5"
	Single Leg Depth Jump with Rebound	2 x 8 each leg	
	Power Bound	2 x 40 m	
	Single Leg High Jump	2 x 10 each leg	
5-8	Double Leg Hurdle Jump with Rebound	2 x 10	2.5"
	Single Leg Hurdle Jump with Rebound	2 x 8 each leg	
	Double Leg Depth Jump with Rebound	2 x 10	
	Single Leg Depth Jump with Rebound	2 x 8 each leg	
9-10	Single Leg High Jump onto Box	2 x 8 each leg	2.5"
	Single Leg Depth Jumps with Rebound	2 x 8 each leg	
	Power Bound	2 x 30 m	
	Speed Bound	2 x 30 m	

Late Season/Peak (1x Week, Tuesday)		
Week	Exercise	Rest
1-2	Single Leg High Jumps onto Box Single Leg Depth Jumps with Rebound Single Leg Hurdle Hop with Rebound	2 x 6 each leg 2 x 6 each leg 2 x 6 each leg

Active Rest (2 Weeks)

The athlete can choose whatever type of training she finds enjoyable...the focus is on recovery and having fun!

References

- Bowerman, W.J., & Freeman, W.H. (1991). High-performance training for track and field. Champaign, IL: Leisure Press.
- Dapena, J. (1992). Biomechanical studies in the high jump and the implications to coaching. Track and Field Quarterly Review, 92(4), 34-38.
- Dursenev, L.I. (1991). Concerning one of the concepts of improving high jumpers. Soviet Sports Review, 26(2), 60-61.
- Fidler, S. (1992). High jump. Track and Field Quarterly Review, 92(4), 29-33.
- Kraemer, W.J., & Häkkinen, K. (Eds.). (2002). Strength training for sport. Oxford: Blackwell Science.
- Meyers, B. (1990). High jump inventory. Track and Field Quarterly Review, 90(4), 24-25.
- Rogers, J.L. (2000). USA track & field coaching manual. Champaign, IL: Human Kinetics.
- Schweigert, D. (1992). Dynamic high jumping. Track and Field Quarterly Review, 92(4), 39-42.
- Schweigert, D. (2000). Functional strength considerations for the advanced high jumper. Strength and Conditioning Journal, 22(5), 25-30.
- Zatsiorsky, V.M. (1995). Science and practice of strength training. Champaign, IL: Human Kinetics.