Sustainable Development In Sports Through Coaches Effective Guidelines For Planning A Plyometric Training Session

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DOI: 10.56773/apesj/V2.i2.36

Abstrak: Plyometric is a form of advanced fitness training that uses fast muscular contractions to improve power and speed in the sports performance by coaches and athletes. The paper presents how plyometrics works, types of plyometric and benefits of using plyometrics are also offered. It highlighted a lot common mistakes coaches make while using plyometric training such as improper progression, skipping the prerequisites, not jumping enough, too much plyometrics, bad landing among others. The paper made some useful conclusions as well as recommendations that will improve athletics in modern sports such as NUGA and Olympic Games.

Keywords: Concentric, eccentric, plyometric training, stretch-shortening cycle

INTRODUCTION

Plyometric is a form of advanced fitness training that uses fast muscular contractions to improve power and speed in the sports performance by coaches and athletes. Plyometric training involves a rapid stretching of muscle (eccentric phase) immediately followed by a concentric or shortening action of the same muscle and connective tissue. This rapid combination of eccentric and concentric action by muscle is called Stretch-Shortening Cycle (SSC) (Uzor & Ujuagu, 2020). The Stretch-Shortening Cycle (SSC) exists in all forms of human motion from changing direction in soccer, to jumping in basketball, and even sprinting in the 100m. As a muscle stretches and contracts eccentrically, it lengthens while it contracts to produce storable energy. The stored elastic energy within the muscle is used to produce more force than can be provided by using only concentric contraction alone (American College of Sports Medicine, 2009).

According to Uzor, Iwuoha, Ujuagu & Offodile (2023), plyometric training comprises quick muscle stretching (eccentric phase) followed by concentric or shortening of the same muscle and connective tissue. Stretch-shortening cycle refers to the quick combination of eccentric and concentric muscular action. A muscle lengthens and contracts eccentrically to produce storable energy as it stretches and contracts. Plyometric training bridges the gap between speed and strength. The two main categories of plyometrics are lower and upper body plyometric training (Quinn, 2013). Lower body plyometric training includes jumps, hops, bounds and lunges, while the upper body plyometric training requires the use of a medicine ball throws and plyometric push-ups (Walker, 2014). Its health

benefits include improved measures of muscular strength and power (Quinn, 2013), reduced incidence of serious knee injuries (Elite Athletic Performance, 2013), and running economy (Bhavna & Sarika, 2010). Studies have shown that plyometric training greatly improved speed, vertical jump, leg strength, agility and kicking distance after the training (Beardsley, 2014; Coach Colleague, 2009; Matz, 2013; Quinn, 2013). Plyometric and weight training can enhance strength performance (Harrison & Gaffney, 2001; Hennessy & Kilty, 2001). Rimmer and Sleivert (2000) narrated that a plyometric intervention programme resulted in an improvement in sprint and decrease in ground contact time. These research studies provide support for the integration of plyometric training in conjunction with normal sport practice in sports in order to improve sports development.

According to Glendinning (2014), running is the most form of plyometric training and can be safe for a wide variety of populations. Each step in running requires a loading phase, and then an immediate, explosive contraction phase. There are many plyometric exercises that are safe for a wide variety of people. Studies have shown that plyometric training can be used often by athletes who need to generate quick burst of maximal effort, movement required in most popular sports such as football, basketball, track and field events, racket games, rugby and martial arts in a short amount of time (Comyns, 2012; Idea Health Fitness, 2009; Quinn, 2013). Though plyometric training is a very potent training modality for improving sports performance, there are several important issues and common mistakes coaches and athletes must fully understand and take into consideration before they attempt plyometric training. Too often, coaches with good intentions do more harm than good when using plyometric training. They might be using great exercises, but wrong sets/repetitions and inadequate rest.

How Plyometrics Works (Stretch-Shortening Cycle)

There are three distinct phases involved in Stretch-Shortening Cycle (SSC) namely: eccentric or loading phase, amortisation or transition phase, and concentric or unloading phase (Arazi & Asadi, 2011).

A. **Eccentric Phase:** The eccentric phase is where preloading and stretching of the muscle occurs. During this phase, the stretching of the muscle stimulates the muscle spindle. The muscle spindle sends out a signal that ultimately causes the muscle to contract.
B. **Amortisation Phase:** The amortisation phase is the transition from eccentric to concentric phases. It is quick without movement. Simply stated it is the time that elapses between landing and jumping again. The amortisation phase is the most important phase and must be kept short. A prolonged amortisation phase results in less than-optimum neuromuscular efficiency from a loss of elastic potential energy.
C. **Concentric Phase:** The third and final phase of the SSC is the concentric phase. It follows the amortisation phase and comprises the entire push-off time, until the athlete's foot leaves the surface.

Types of Plyometric Exercise

There are two major categories of plyometric exercises namely; plyometrics based on the body affected and plyometrics based on the sports-specific. Examples of plyometric based on the body affected are lower body plyometrics and upper body plyometrics while examples of plyometrics based on sports-specific includes; rhythm, power, speed and individualised plyometric exercises. The following were the examples of lower body plyometric and upper body plyometric training.

Lower Body Plyometric Training

A	Double and Single Leg Hops	J	Squat Jumps
B	Power Skipping	K	Jump to Box
C	Power Bounds	L	Lateral Jump to Box
D	Hurdle Hops	M	Tuck Jump
E	Standing Triple Jumps	N	Split Jump
F	Box Jumps	O	Bounding
G	Single Jumps	P	Zig Zag Hop
H	Depth Jumps	Q	Lateral Hurdle Jumps
I	Single Leg Truck Jump	R	Bounding With Rngs

Upper Body Plyometric Training

A	Power Push-Up	G	Medicine Ball Throws
B	Wheelbarrow Walks	H	Twist Tosses
C	Overhead Trhows	I	Slams
D	Over Back Toss	J	Side Trows
E	Explosive Squat Throws	K	Squad Throws
F	Single Arm Overhead Trows		

There are many other plyometric exercises for both the lower and upper body. As with other forms of sports training, exercise selection should mimic the movement patterns of the sport as closely as possible. Lindsey (2014) explained that lower body plyometric exercises are suitable to develop power in many sports such as basketball, tracks and field athletics, sprinting, soccer, hockey, rugby and baseball. In fact, performance in any sport that involves jumping, sprinting or kicking can be improved with lower body plyometric exercises. These lower body plyometric exercises are most effective when completed in conjunction with a suitable strength training programme or following a phase of maximal strength training. There is no evidence to suggest that the risk of injury is increased during plyometric training in adults. However, as a precaution, several safety guidelines have been recommended to keep plyometric exercises as safe as possible. Because plyometric has received little scientific study compared to conventional strength training, there are no definitive guidelines regarding sets, repetitions and frequency among others.

Benefits of Plyometrics

There are many benefits of using plyometrics, which include the following according to Elite Athletic Performance (2013):

1. **Enhance Performance:** Since plyometric can boost one's running speed, one's performance can improve a lot. Even if someone are involved in an activity that does not involve running, plyometrics can still help that person, because one can be better at throwing farther or punching harder. Plyometric training can help one achieve almost all athletic goals.
2. **Enhanced Muscular Power and Speed:** Plyometrics were originally designed for power athletes like sprinters, football players and gymnasts. In sports performance, the most important element is power. Power is the amount of force which can be generated in the shortest time frame possible. In a layman terms, this is the speed of muscle contraction. Power is determined by the time it takes for muscular strength to convert into speed. A short, fast muscles contraction will produce higher energy than slower and more powerful contraction. Increasing muscular power by quickly converting muscular strength into speed gives athletes the ability to perform movements that strength alone cannot allow. Therefore muscular power and muscular strength are not the same Power= Mass x Speed /distance.
3. **Burns Calories and Reduces Weight:** Plyometric exercises require a lot of energy, because they are highly intense. They utilise the whole body and activate most muscle groups, therefore burning many calories in a single session and aiding in weight loss. The repetitive landing causes entire leg muscles to contract, helping to improve overall tone and definition. Plyometrics combine strength training and cardiovascular exercise, allowing an individual to "kill two birds with one stone"
4. **No Extreme Exercising Equipment is needed:** Exercise equipment can be expensive, and plyometric exercising does not require any. Plyometric does not require an individual to buy any such equipment. Anything that is needed could be easily found lying around the house or office to complete your exercise routine with them.
5. **Easily Calibrated to Suit anyone's Needs:** Plyometric exercising can be calibrated to suit anyone's needs. An individual can be as simple as jumping on trampoline several times a day or even using your old jump rope. For someone looking for a little more intense workout, perhaps jumping back and forth from a lower platform to a higher platform would suit their needs. There are many ways to increase the intensity of the exercise by simply increasing the distance or height of each jump. Plyometric exercising is simply utilising the muscular energy that it takes to jump to your own exercising advantage. The right plyometric training depends upon the individual's needs and fitness levels.

Common Mistakes with Plyometric Training

Plyometrics are great drills that are effective and also a very simple method to increase speed, power and overall athletic performance. According to Melissa's Ultimate Fitness (2011), there are some of the most common mistakes people make when training using plyometric training which includes the following:

Mistake № 1: Improper Progression

Doing high intensity plyometrics before adapting to low and medium level plyometrics increases the risk of injury. Though a programme may prescribe doing certain exercises for a certain number of weeks, the athlete should not progress to more complicated or intense exercises until the basics have been mastered. Any other strategy is asking for injury. Athletes should be able to perform all exercises and reps with maximuim intensity, good form and body control.

Mistake № 2: Skipping the Prerequisites

Plyometric training should not be done in isolation, but as part of a complete training programme that includes strength training. Athletes will be better prepared by focusing on functional single leg strength rather than 75veremphasizing their maximum squat strength. Equally, before doing medium and high intensity plyometrics, the athlete must have proper landing mechanics. If the knees cave inward when landing, more strength is needed. Any athlete can begin with low intensity plyometric exercises but medium and high intensity plyometric should not be done until the prerequisites are satisfied.

Mistake № 3: Not Jumping Enough

Simply put, athletes who are looking to jump higher often aren't jumping enough. Many athletes will like to do anything to improve their jumping ability, besides actually jumping. Until athletes are getting at least 50-100 maximal jumps in a week, they should not be thinking that there are magic bullets outside of jumping itself that will help them in their quest for a better jump.

Many athletes of course are already getting plenty of maximal jumps in the course of playing their sport and in this case, they would be exempted from many extra efforts, but many athletes looking to jump higher are not getting enough jump attempts, period.

Mistake № 4: Too much Plyometrics

The volume of plyometric exercises that should be done first depends on the intensity of the exercise. Low intensity plyometrics such as jumping rope and warm up type of plyometric (like butt kicks and high knees) can be done in high volume. The volume of moderate and high intensity plyometrics however, must be monitored carefully to avoid too much stress on the joints and ligaments.

The general way to measure volume in a plyometric programme is by ground contacts (how many times you land). Even elite athletes do not exceed 120 ground contacts of high intensity plyometric exercises. A very general guideline is to choose 3 appropriate exercises and perform3-5 sets of 5 reps as a plyometric module that can be done 2-3 times per week. Vary the exercises so that you are not doing the same exercise more than once per week. We have heard the quote “too much of anything is bad”, this goes right with plyometrics.

Mistake № 5: Bad Landing

Most injuries don’t come from jumping but from the landing phase. This is one of the most important aspects for a personal trainer or sports performance coach to teach any athlete or client. If you see someone landing like two legs curved in ward that is really bad. Plyometric is a specialised exercise that the athlete needs to be properly prepared to land and absorb such impact. Before starting to get into high skilled and impact plyometrics make sure that the person has gone through a strong foundational phase that has taught the basics of landing, force, absorption and reaction.

Mistake № 6: Over-Conditioning

Athletes who are doing too much conditioning will find that, no matter what their efforts are, they would not be able to quite get that explosive pop they are looking for. This limit on conditioning is also going to differ from each athlete. The muscular fast-twitch fireplug athlete typically isn’t going to respond all that well to slogging laps around the football field. On the other hand, younger athlete of moderate twitch and power can still benefit from an appropriate amount of conditioning to their sport, as they are built to tolerate this well. Therefore, as a rule of thumb, if you are looking to jump higher, limit aerobic and interval style training to less than 60 total minutes per week or less depending on the tolerance to aerobic work

Mistake № 7: Not Enough Recovery

Basically, this common mistake can happen in two ways:

The first way for this to happen is when you go out and train hard, hitting the weights or doing some intense plyometrics and then instead of resting up you spend another 2 hours playing pickup games. And then you do the same thing the next day as well. The day after that, despite giving your body no time off for rest and recovery, you train hard again, and probably spend another hour or two playing. This pattern is then repeated over and over and then people wonder why their vertical is not really improving very much. There are several things that occur here that are going to have a negative effect on your results. The first is that you are never giving your body a chance to recover from the workouts. The second is that all the sports you are playing can actually have a de-training effect on your vertical jump

training. A vertical jump is an all out explosive movement performed once. It is an expression of power.

A classic example is playing basketball for several hours a day. Doing this in no way resembles all out explosive single efforts, but many, many sub-maximal efforts. This is a conundrum of course. People who play basketball want to jump higher to help them be better basketballers, but to do that they need to stop playing so much basketball. There is no easy solution and ultimately it comes down to whether or not your skills are such that increasing vertical jump will provide better returns than working on your crossover.

Recommendations/Conclusion

To most effectively utilise plyometric training, a coach should keep some safety guidelines in mind when implementing plyometric training programme. Plyometric training is a highly skillful and coordinated movement, it is important to fully understand the nature of this type of training. Plyometric exercises, like other forms of fitness training carry risk when used incorrectly and recklessly. To minimise the chance of injury, it is important that coaches gradually allow the athletes to progress from simple to advance plyometric exercises. The authors suggest that the plyometric exercises should be thus

1. Coaches should allow plenty of rest between plyometric workouts.
2. Coaches should pay attention to injury warning signs.
3. Coaches should subject athletes to warm up thoroughly before starting plyometrics.
4. Athletes must be well-conditioned and have good levels of physical strength, flexibility and proprioception (in body awareness) before commencing plyometric training.
5. Athletes must be instructed on the proper techniques before commencing any plyometric exercises such as the landing techniques and land softly to absorb shock.
6. Coaches should provide a landing surfaces that should be shock absorbing for depth jumps such as gymnastics rubber mats, suspended grass. Hard surfaces should never be used.
7. Coaches should recommend Plyometrics only for well-condition athletes.
8. Coaches should use only plyometric boxes that are sturdy and have a non-slip top.
9. Coaches should encourage athletes to use footwear with plenty of cushioning.
10. Coaches should encourage the athletes to wear shoes that provide good ankle and arch support, and a wide, non-slip sole, such as a basketball or aerobic shoe. Do not perform plyometrics while wearing running shoes.

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