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Plyometric Training for Health-Related Fitness

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ABSTRACT
Plyometric exercise takes advantage of the pre-loading of the muscles which induces a more powerful contraction. Plyometric training is typically reserved for the performance-related fitness training of athletes. However, with the considerable physiological adaptations resulting from plyometric training, researchers are recommending that this training be incorporated into resistance training programs for the general population. An important benefit of this type of training is that it specifically targets the decline in power associated with aging. This article also provides some practical guidelines to follow to modify plyometric training so that it is more appropriate and accessible to the general population. **Health & Fitness Journal of Canada 2009;2(1): 13-16.**
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INTRODUCTION

Plyometric training was created by Dr. Yuri Verkhoshansky in the Soviet Union and was originally known as “shock training” (Kutz 2003). Fred Wilt, a U.S. track and field coach, is credited with coining the term “plyometric”, meaning “measurable increases”. These increases pertain to the intended outcome of plyometric training, which is to increase the rate of force development or power. Typically, plyometric training is utilized by athletic populations, as it was originally developed for the Soviet Olympic team. However, it is entirely feasible and certainly beneficial for the average physically active person to incorporate some plyometric activities into an exercise routine. To examine the relevance of plyometric training to a non-athletic population, it is important to understand what plyometric training is and the associated physiologic benefits. It is also crucial to modify the typical plyometric exercises designed for high performance goals to exercises intended for lifestyle or recreational goals.

Plyometric training, also known as stretch-shortening cycle exercise, is a type of power training that exploits the eccentric, isometric and concentric sequencing of most movements. If this sequence is progressed through rapidly (i.e. there is no pause between the phases) there is a stretching or pre-loading of the working muscles which results in a more powerful concentric contraction. This more powerful contraction is primarily due to the stored elastic energy from the pre-loading of the muscles, similar to stretching a rubber band or lengthening a spring - the natural tendency is to return rapidly to its original length. This is easily demonstrated with a jumping example; when performing a vertical jump, if you dip at the knees and hips (lengthening the muscles) you will jump higher if you do not pause in the semi-squat position before jumping. If you

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delay the concentric action by pausing before the jump, the potential energy is gradually lost which results in a lower jump height.

There are other theories regarding the explanation of this phenomenon. Moore and Schilling (2005) summarized four proposed mechanisms to explain the increase in power: i) the elastic properties of the muscles, whereby pre-loading results in stored elastic energy (described above);ii) neural stimulation, whereby more motor units are recruited because of the increased load that triggers a counteraction to the exaggerated stretch placed on the muscle from the eccentric loading phase (preload); iii) alterations in contractile properties as additional force on the tendon duirng the shortening phase results in greater extension; iv) agonist muscle action in response to the pre-load, allowing for cross-bridge attachment before the shortening phase. Regardless, the net effect is that during plyometric exercise the eccentric and concentric sequencing of movement is accelerated. The eccentric contraction pre-loads the muscle and activates one of the mechanisms as outlined above which works to increase the power of the concentric action.

Considerable physiological adaptations and performance improvements have been attributed to plyometric training. Some outcomes have been proven, while others are still unfounded. It has been suggested, for example, that plyometric training may improve muscular activation patterns (Lephart et al. 2005), improve bone mineral density (Kato et al. 2005), increase muscular power and strength (specifically improvements in vertical jump height), increase joint stability, increase muscle fiber size and, in some cases, reduce injuries (Hewett et al. 1996). The importance of these improvements becomes increasingly more apparent with aging. It is well known that, with aging, force production capapbility (i.e. muscle power) capability decreases and bone mineral density decreases. Both of these decrements can be offset by plyometric training. Since much of the decline has taken effect by middle age, this is a good reason to implement plyometric training in this age group. Further, researchers have suggested that the ability to produce powerful movements declines more rapidly than maximum strength (Surakka et al. 2003). This may be primarily due to type 2 muscle fibre atrophy (Faulkner and Brooks 1995) in addition to sarcopenia. Loss of type 2 muscle fibres may be a result of decreased physical activity participation as we age (Faulkner et al. 2007), and particularly a reduced participation in activities that involve explosive power. Hence, the fundamental and most relevant improvement that results from plyometric training is an increased power output. This makes plyometric training unique from strength training, which is typically the focus of resistance training programs.

Both aerobic exercise and resistance training are the foundations of good physical health. However, utilizing plyometric exercises as a power component within a resistance training program provides a more well-rounded exercise regime. Aerobic training enables sustained work whereas resistance training helps to increase muscular strength and power. However, resistance training focused purely on strength training does not address the decline in power that occurs with aging. Therefore, it is important to encourage the general population to participate in power training and more specifically, plyometrics. This is easily facilitated by modifying the customary high-performance plyometric exercises to those more appropriate for the general population. Although the guidelines for plyometric training are typically presented in the context of the trained athlete, the same principles can be adapted and applied to the moderately active middle-aged man or woman.

GENERAL GUIDELINES

- Plyometric training is not for the beginning exerciser.
- The exerciser should have an adequate foundation of strength training before incorporating plyometric exercises into

a workout

- Progression is key– start with basic plyometric exercises and progress to more complex. For example, progress from jumping in place to box jumps.
- Weights should not be added to the exercises - the exercises should only use the individual's body weight as resistance
- It is recommended that the exerciser seek a knowledgeable fitness professional if he/she would like to progress to more complex exercises.

FREQUENCY AND TIME

- Plyometric exercises should be incorporated into an already defined resistance training program.
- To allow for ample recovery time, plyometric exercises for the same muscle group should be performed no sooner than every second day.

TYPE

- Lower body; jumping jacks, rope skipping, burpees
- Upper body; wall clapping push-ups, chest passes (medicine ball)
- Whole body; (trying to incorporate some aerobic aspects) hill running, stair climbing

INTENSITY

- Begin with light intensity and progress to more moderate intensity. Light intensity would involve slower movement, simpler exercises and less repetitions. For example, before executing clapping push-ups, begin with clapping wall push-ups.
- Supporting one's body weight should suffice for the general population; there is no need for external weighting.
- Once the beginner exercises are mastered, increase speed and/or complexity of action.

Many injuries that occur during plyometric exercises happen because the exerciser has not followed a proper and logical progression of exercises, for example, starting with box jumps that are too high. Also, since much stress is put on the body with plyometric training, it is important to start slowly and progress at a reasonable pace. There is little evidence to suggest that there is an increased risk of injury with plyometrics (as compared to general strength training programs). However, if you do not progress slowly, the risk of injury will undoubtedly increase.

Despite concerns regarding the associated risks for the average exerciser, plyometric training has been found to be feasible for the general population (Surakka et al. 2003). Research supports implementing plyometric training within the general population, as the benefits associated with an appropriate program outweigh the risks. However, with any exercise program it is important to adhere to precautions and standardized screening so that established exercisers will benefit by incorporating some plyometric exercises into their program. Plyometrics should not be a mystery to the non-athletic population. Jumping jacks and downhill jogging are not as complex as double leg kangaroo hops or lateral hurdle jumps, but they still work to pre-load the muscle, resulting in a more powerful contraction. This is advantageous to the non-athletic population as it offsets the loss of power with aging that is not addressed by standard resistance training.

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AUTHOR QUALIFICATIONS

The authors' qualifications are as follows: Melissa Crawford MSc, CSEP CEP; V. Roni Jamnik PhD, CSEP CEP

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