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HOW INTRODUCING ISOINERTIAL EXERCISES USING A FLYWHEEL CAN IMPROVE THE TRAINING OF ATHLETES: A SYSTEMATIC REVIEW

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Abstract: *Considering the results obtained by athletes from our country in recent years, finding new training methods and means is necessary for their improvement. This literature review aims to demonstrate the importance of improving and modernizing the speed training of sprinters and to incorporate the most relevant information from specialist. For this paper we focused on isoinertial training which is achieved with a device that maintains constant resistance throughout the movement, during the contraction of the muscle and in the relaxation phase. A search of electronic databases [PubMed, JSSM, Web of Science, Google Scholar] was conducted to identify all publications employing the isoinertial training up to Feb. 2023.*

Key words: *isoinertial training, sport, performance, strength, flywheel*

1. Introduction

As in any field, the world of sports has allowed itself to be dominated by modern technology. The vast majority of coaches, teachers and athletes are aware of the latest equipment and specialized studies made through modern technologies, allowing the change of classic types of training for the benefit of progress.

Finding the best means of improving physical fitness and sports performance preoccupies researchers around the world, which has led to the construction and use of new machines and modern technological devices, either to test

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athletes or to help them in training. The efficiency of training in the shortest possible time is pursued by as many athletes and coaches alike, that's why new methods and means of training were developed and performances began to be improved.

Bompa (2002) believes that achieving performance in athletics is the result of a pedagogical process of sports training and education, carried out over several years [5].

Isoinertial training is achieved with a device that maintains constant resistance throughout the movement, during the contraction of the muscle and also in the relaxation phase. That making the muscles works at maximum force at any angle.

Resistance is created by the inertia of a flywheel, using the muscle force conducted by the user's movement to accelerated or decelerated [12].

Specialized studies in the field have discovered and summarized the following advantages of using isoinertial training:

- Most studies stated that athletes' performance improved, in some cases by at least 30%;
- Stimulates muscle development by activating muscle mass;
- Athletes' risk of injury is lower than with regular strength training
- Muscle pains are reduced;
- The amplitude of movements is improved, allowing an effective and safe training in a shorter time;
- The training sessions are intense and impressive;
- It can be easily adjusted by athletes for achieving their goals
- During the movement the muscles use their maximum capacity;
- This type of training can also be used in recovery as specific areas can be worked;
- It requires less cardiopulmonary effort;
- The parameters (power, speed) are visible in real time.

Contemporary literature suggests that training with a flywheel may be a valid alternative to traditional resistance training methods, but has not proven superior in elite athletes, and this will require further research in the future [1].

2. Objectives

This literature review aims at demonstrating the importance of improving and modernizing the speed training of sprinters and to incorporate the most relevant information from specialist articles on the subject in question.

3. Methods

For this review we used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement [15], [17].

3.1. Inclusion Criteria

We based our research on track and field athletes especially on sprinters.

3.2. Exclusion Criteria

Studies identified through the literature search were excluded if:

- They didn't used a machine with a flywheel in their training.
- It was used for the athletes with special needs/ used in recovery.

- It wasn't used for athletes.
- It wasn't used for increasing the strength or speed.
- Studies that weren't dated as Open Access

3.3. Information Sources and Search

3.3.1. Study Selection

A search of electronic databases [PubMed, JSSM, Web of Science, Google Scholar] was conducted to identify all publications employing the isoinertial training up to Feb. 2023.

Search strategies used in the databases included combinations of key search terms, which were divided into three concepts: (1) domain ("sports" OR" physical education", (2) study design ("isoinertial training program "OR "experiment", (3) intervention type ("athletes "OR "sprinters" OR" track and field runners" OR "isoinertial training flywheel").

We selected the studies that met our selection criteria and then they were subjected to a more detailed analysis.

3.3.2. Data Collection Processes

We extracted study data relating to the general characteristics of each study (i.e., author, date, study name, where it was published, measures and outcomes, results and further discussions);

4. Results

The initial search identified 657 papers:

- 589 in Google Scholar,
- 36 in PubMed,
- 31 in Web of Science and
- 1 in Journal of sports, science & medicine.

Before screening we removed 521 duplicate records and that left us with 136 records screened. We excluded 114 records for the following reasons:

- Reason 1 – They did not use a machine with a flywheel in their training. (n=43)
- Reason 2 – It was used for the athletes with special needs/used in recovery. (n=2)
- Reason 3 – It wasn't used for athletes. (n=27)
- Reason 4 – It wasn't used for increasing the strength of speed (n=27)
- Reason 5 – Studies that weren't dated as Open Access (n=15)

The number of reports assessed for eligibility and the studies included in this review were in number of 22.

4.1. Benefits of using isoinertial exercises with a flywheel

The idea of isoinertial training was studied in recent years, with the first effective results dating back to the 1990s (Colliander and Tesch) and 1991 (Dudley, Tesch, Miller, Buchanan) [7], [10].

Originally exercises using a flywheel were used by astronauts for alleviating neuromuscular dysfunctions and concomitant musculoskeletal atrophy caused by the absence of gravity during long-duration space travel. Studies by Dudley (1991); Berg & Tesch (1994) and Norrbrand (2008) elaborated on this subject [10-3-14].

According to previous studies, researchers believe that flywheel training contributes to muscle mass growth due to the hypertrophic aids of the exercises, from the mix of concentric-eccentric contractions [14] and not just by eccentric overload alone[23].

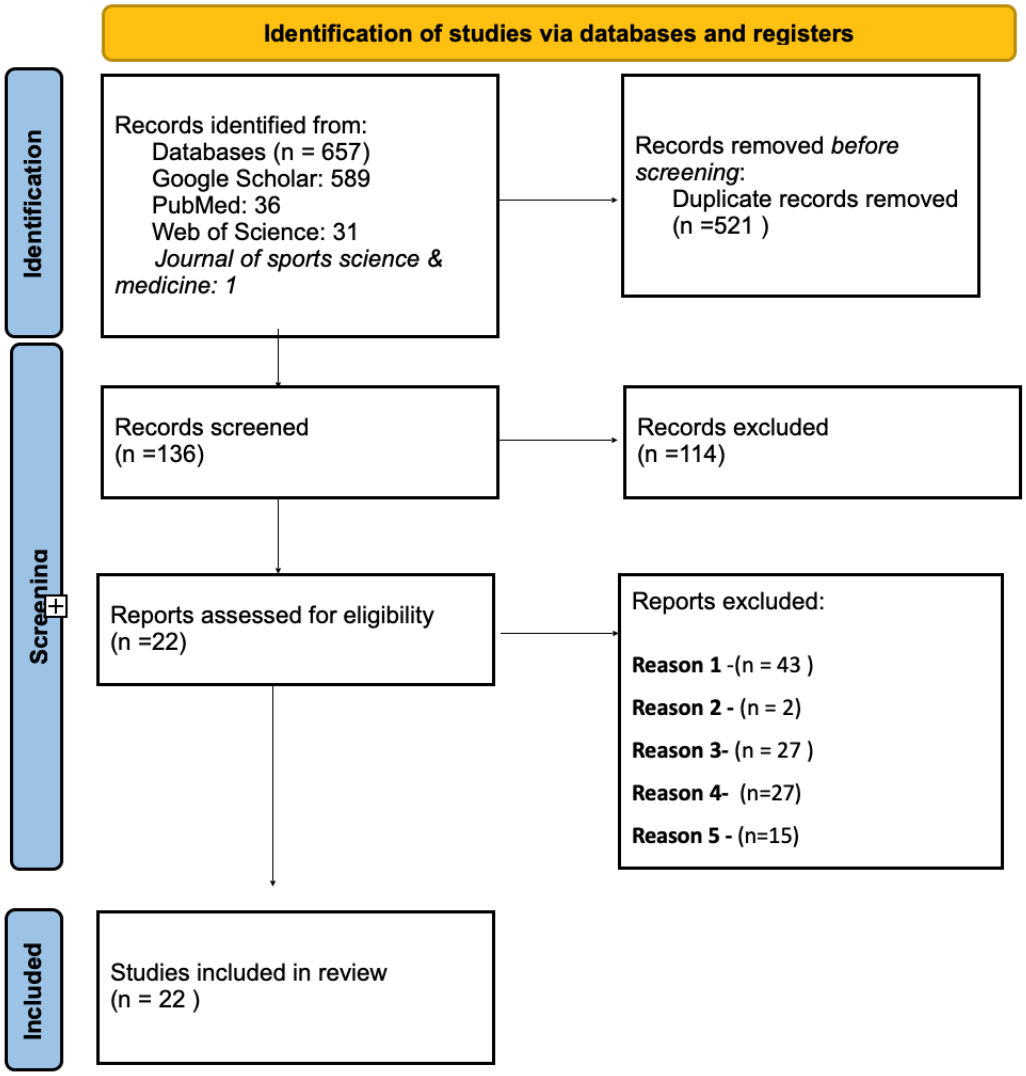

Fig. 1. *PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only (http://www.prisma-statement.org/PRISMAStatement/PRISMAStatement)* [17]

Weakly et al. (2019), demonstrated that devices with flywheels can be used in resistance training for increasing lean body mass, strength, and power [22].

Studies proved the mechanical advantages of fly wheel devices and explained the neuro-physiological mechanisms and morphological adaptations that result from using flywheel exercises as conditioning strategies. [13], [18], [2], [8].

Analyzing the movement from a mechanical perspective, during eccentric contractions the muscles act while

lengthening due to the applied external resistance (Douglas et al., 2017) [9].

Using flywheel exercises have a mechanical advantage due to the fact that the eccentric phase is overloaded by the inertia accumulated during the concentric phase only if the latter is performed at maximum effort [13].

Eight studies deepened what happens at the molecular level during muscle contractions and how Post-Activation Potentiation Enhancement /PAPE can be improved by using traditional resistance exercises as well as those that use a flywheel [4], [6], [19].

When an isoinertial technology was used in training programs, the fundamental results displayed that all the variables analysed were increased, particularly explosive strength and repeated sprint ability. Those results were obtained by Munoz et al. (2021) who implemented flywheel exercises into training for four weeks, they considered that in this amount of time the direction changes, resistance to repeated sprinting and explosive leg strength were improved [16].

Another study claimed that “resistance training has a limited transfer to rapid force development in unloaded dynamic isoinertial multi-joint movements and this effect is most pronounced in movements that do not involve a counter movement.” The review concluded that this transfer is less noticeable in well-trained persons (Van Hooren, 2017) [20].

4. Discussions

The aim of this literature review was to demonstrate the importance of improving and modernizing the speed training of sprinters and to incorporate the most relevant information from specialist articles on the subject in question.

Although the performance of sprinters is mostly based on genetic traits, studies and experiments show that it can be improved through proper training and the advancement of technology. Isoinertial training is carried out with the help of a device that maintains constant resistance throughout the movement, both during the actual contraction of the muscle and during the relaxation phase. That making the muscles work at maximum force at any angle, which makes this type of training much more effective than classic strength machines.

Considering that this type of training is relatively new, there is room for research on this topic. Some of the first studies that investigated this topic (de Hoyo et al., 2014 [8]; Tesch P. A. et al., 2017 [18]; Maroto-Izquierdo S. et al., 2017[13]; Beato M. et al. 2019d[2]) showed that isoinertial training using a flywheel device has beneficial results for athletes and therefore should be incorporated into their classic training routine.

5. Conclusions

Introducing isoinertial training to athletes' training has proven to be helpful in improving their athletic performance and fitness, its benefits being identified and demonstrated in multiple studies. It follows that the modernization of the

training process involves both the use of modern technology and new training methods, not only at high performance, but especially at the junior level, but especially at the junior level.

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