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OPTIMISING THE EFFORT CAPACITY IN THROWING EVENTS

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Abstract. *Background*. Throwing disciplines in track and field–including shot put, discus, and javelin–demand more than just raw strength and explosive power. Athletes must also develop the ability to sustain physical effort during high-intensity, repetitive training sessions. While the competitive performance itself is largely anaerobic and relies on short bursts of maximal effort, day-to-day training places significant demands on the athlete's overall work capacity, where aerobic fitness plays a key role in recovery, fatigue resistance, and maintaining technical precision throughout the session.
Despite this, most of the focus in research and practice has traditionally been on improving maximal strength and speed of execution. The role of aerobic conditioning has often been overlooked. However, recent studies point to the benefits of a well-developed aerobic system–not just for endurance sports, but also for improving training quality and efficiency in explosive disciplines. Better aerobic capacity allows for quicker recovery between sets, greater resistance to fatigue, and more consistent neuromuscular performance under prolonged effort. As a result, incorporating moderate to high-volume training in mixed aerobic-anaerobic zones is becoming increasingly relevant in planning effective training programs for throwers.
Objectives.
- Establishing the tests and the control samples;
- Establishing the motor profile;
- Results processing;
- Elaboration of a specific athletic program to improve motor skills,

Methods. bibliographic study method, observation method, experimental method, statistical-mathematical method.
Results. With the help of aeroscan machine, we were able to observe the aerobic effort sustained by the throwers during of the training sessions.
Conclusion. In conclusion, optimizing effort capacity in throwing events can be achieved through an integrated training approach that combines both anaerobic and aerobic exercises. Specific training methods, such as throwing with different weighted implements and high-intensity interval training, have shown significant improvements in performance, including better fatigue management and recovery between sets. A well-rounded training program, tailored to the athlete's needs, is crucial for enhancing both technical execution and overall performance in competition.

Keyboard: throwing events, aerobic, effort.

1. Introduction

Optimising effort capacity in throwing events such as shot put, discus, and javelin requires much more than just developing muscular strength and explosive power. While these physical qualities are indeed fundamental for competition performance (Mathews & Fox, 1976), effective training

demands a more complex and holistic approach. Throwers often face high training volumes, with long and intense sessions where maintaining proper technique is crucial. An athlete who can sustain consistent performance during these demanding periods, without succumbing to early fatigue or technical breakdowns, will have a greater chance of steady progress and reduced injury risk (Barrow & McGee, 1979).

Exercise physiology research highlights the critical role of aerobic capacity in supporting athletes during repeated high-intensity efforts. A well-developed aerobic system aids in faster recovery between sets, which helps delay fatigue accumulation and maintain training quality over time (Foster & Lucia, 2007; Taylor & Rowell, n.d.). Although throwing events are predominantly anaerobic and explosive in nature, integrating training methods that stimulate both anaerobic and aerobic energy systems is essential for comprehensive preparation (Manju & Deepak, 2015; Coleman, 1974).

Various training modalities have proven effective in addressing these energy systems simultaneously. Incorporating weighted implements, medicine ball exercises, and high-intensity interval training (HIIT) helps to optimise both strength and endurance (Carl et al., 2015; Gil et al., 2000). HIIT, in particular, has gained attention for its ability to induce rapid metabolic adaptations, improving overall effort capacity while managing fatigue during intense training cycles. This method is especially beneficial for throwers who must repeatedly perform explosive movements at high intensities over extended periods (Buchheit & Laursen, 2013; Martin & Paul, 2013). Moreover, HIIT blends short bursts of anaerobic effort with aerobic recovery, enhancing both speed and endurance capabilities (Man et al., n.d.).

Targeting both aerobic capacity and neuromuscular adaptations through training is not only beneficial for endurance but also critical for technical execution. Throwing repeatedly requires precise coordination and motor control. Fatigue can degrade technique, so the ability to maintain proper form under fatigue is vital for performance and injury prevention. Athletes who follow well-designed aerobic and anaerobic training plans tend to maintain higher technical proficiency even during intense or prolonged workloads (Schreiber, 1993; Barrow & McGee, 1979).

Another key factor in optimising effort capacity is recognising the individuality of each athlete. Physiological profiles, including somatotype, muscular strength, and neuromuscular characteristics, significantly influence how an athlete responds to specific training stimuli (Astrand & Rodahl, 1970; Schreiber, 1993). Therefore, personalising training programs to suit each athlete's unique needs is crucial for maximizing adaptation and minimizing injury risk.

In practice, this means combining anaerobic-focused sessions that build strength and explosiveness with aerobic components aimed at improving recovery and endurance. Such an integrated approach supports not only the physical development of throwers but also their ability to maintain technique and performance under the stresses of competition and intensive training (Gil et al., 2000; Buchheit & Laursen, 2013).

Finally, ongoing assessment and adaptation of training plans based on the athlete's responses and progress ensure that the program remains effective. This dynamic approach respects individual differences and promotes sustainable long-term development in throwing events.

Subjects and research

The present experiment was realised with the participation of 6 athletes, 3 female and 3 male, aged 16–30 years (m =22), from the track&field. The all subjects have competitional exeprience 5–10 years of competitional experience

Tabel 1. Research subjects

Subjects	Age	Event	Competitive experience
1	16	Discus throw	10 years
2	18	Shot put	5 years
3	22	Javelin throw	9 years
4	30	Shot put	10 years
5	20	Discus throw	5 years
6	26	Javelin throw	10 years

Organisation of research

For this experiment all the athletes were informed about all the details of the tests, the athletes participated as volunteers. all the throwers received the initial results and the final results. Each thrower received an individualized program for the practiced event

Tabel 2. Bruce protocol

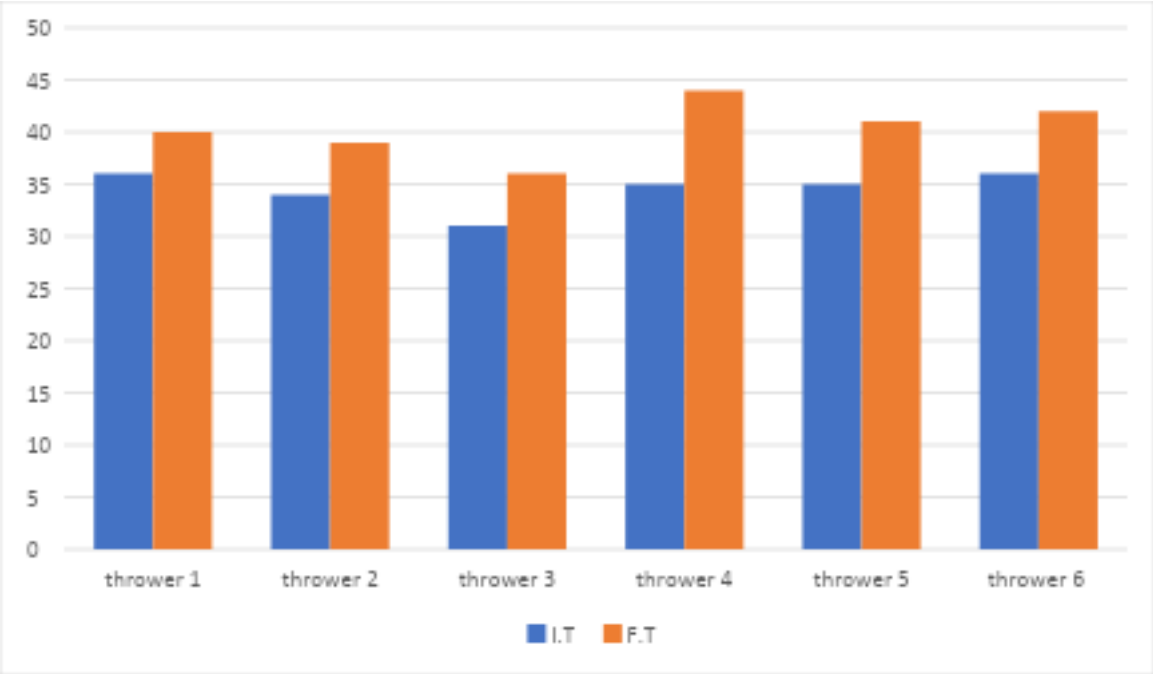
Bruce protocol	Bruce protocol
Level 1	Level 1
Level 2	Level 2
Level 3	Level 3
Level 4	Level 4
Level 5	Level 5
Level 6	Level 6
Level 7	Level 7
Level 8	Level 8
Level 9	Level 9
Level 10	Level 10

Results and Discussions

In this picture we presenting the initial testing and the final testing. (orange- the initial testing, blue- the final testing).

Figure 1.1 show the results of the Aeroscan test, initial and final testing . It can be seen that the values range between 33.5 and 38.1 at the initial testing and a significant increase for the final testing, marking values between 39.3 and 45.3.

Graphic. 1. Aeroscan Results - Initial Testing and Final Testing



With the Wilcoxon test, we were able to more easily analyze the differences between the two tests performed in the present research, so that the Z values, the alpha significance level and the effect size could be recorded.

Interval and variable-intensity training are effective techniques for enhancing exercise capacity, and they can be particularly beneficial for athletes in throwing events in track and field. These methods involve structured sessions where periods of intense effort alternate with active recovery or lower intensity. This type of training offers several physiological and performance benefits that are crucial for throwers aiming to improve their endurance, power, and overall competition performance.

For the development of motor skills we used only specific exercises for throwers. The study was conducted between December and May. Specifically for the training of throwers we used heavy training materials in the winter period, in the pre-competition and competition period we used light materials to improve the thrower's speed.

Conclusions

1. In throwing events, physical exercise has a significant impact on the results of throwers.
2. Thrower training programs are particularly complex, as throwers require multi-faceted training to achieve high performance.
3. Aeroscan – for VO2 max, we were able to record the results of the Wilcoxon test: 4.5, Z value: –2.534, the standard error (SE) threshold: 0.011, and the effect size: 0.7 (very strong effect). These significant results were determined at the $p<0.05$ level ($0.011<0.05$). The null hypothesis is rejected, indicating a significant increase.
4. In conclusion, we can argue that the "optimization of motor skills in throwing events" can be achieved with the help of specific athletic exercises. The results from the initial and final tests clearly demonstrate improved outcomes for the throwers.

Authors' contributions

All authors have equally contributed to this study

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