

The Effect of a Specific Weight Training Program on Power Development in Senior Taekwondo Athletes

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Abstract

This research evaluates the impact of a specific training program on the physical and technical performance of taekwondo practitioners by comparing two groups: a control group that did not follow the program and an experimental group that participated in it. Performance was assessed using Squat Jump, Countermovement Jump (CMJ), Drop Jump tests, as well as strikes with elastic resistance and on a punching bag. The control group showed modest, non-significant improvement in most tests, except for CMJ (1.13%). In contrast, the experimental group exhibited significant improvements in all tests, with progress rates ranging from 5.67% to 10.99%. These results confirm the effectiveness of the specific training program in enhancing the physical and technical abilities of athletes, suggesting that this type of program could be beneficial for the physical preparation of taekwondo practitioners.

I. Introduction

The athletic performance of a taekwondo practitioner lies at the intersection of numerous complex factors that are challenging to master. Until recently, performance was primarily attributed to technical skills. While technical factors are crucial in many sports, the outcome of a competition is not solely dependent on technical or tactical abilities. In taekwondo, performance is influenced by various factors, including strength, speed, endurance, and especially explosive power, which is essential for executing effective striking techniques. The level of these physical qualities, particularly explosive strength, plays a vital role in enabling taekwondo practitioners to fully exploit their potential.

The focus on speed and explosive strength reflects the specific nature of the athletic demands in taekwondo, where intense and rapid efforts are decisive for the outcome of a match. There is a functional link between the explosive strength of the lower limbs and the ability to score points in taekwondo. Beyond physical preparation and technical skills, the level of explosive strength development largely determines the performance of high-level taekwondo athletes.

Explosive power is the ability to generate maximum force in minimal time. For taekwondo practitioners, this translates into delivering fast and powerful kicks essential for scoring points. Studies have shown a significant correlation between lower limb strength and the ability to execute striking techniques effectively, emphasizing the importance of specific strength training.

The primary objective of this study is to examine the effect of a specific weight training program aimed at developing power and to evaluate its impact on the physical and technical development of senior Algerian taekwondo athletes over a training macrocycle. Given the specific demands of this sport, which rely heavily on intense and brief efforts, the program seeks to enhance strength and explosiveness, ultimately maximizing combat efficiency, particularly by improving the athletes' ability to perform rapid and powerful movements.

Problem Statement:

The relevance of introducing a weight training program that systematically incorporates exercises targeting explosive strength and power, combined with technical drills, in the preparation of taekwondo practitioners for

optimizing their explosiveness is raised. By integrating such a program with sport-specific technical training, it is hypothesized that an optimized development of explosive qualities—crucial for improving performance in taekwondo—can be achieved.

Hypothesis:

We hypothesize that the use of appropriate training methods and tools, alongside a strength training regimen specifically tailored to the demands of taekwondo, will enhance power and explosiveness in taekwondo athletes. By focusing particularly on the development of lower body strength to improve muscle explosiveness, we anticipate that this program will also increase execution speed and reactivity during combat.

1. Methodological Framework

1.1 Experimental Design

The study employs a quasi-experimental design with pretests and posttests to assess the impact of the training program. This approach involves two groups:

- **Experimental Group:** Receives the specific weight training intervention combined with their regular technical training. Performance outcomes are measured before and after the program.
- **Control Group:** Does not receive the intervention and continues with their standard training regimen during the same period. They undergo identical pretests and posttests to allow for comparative analysis.

This design enables the measurement of changes attributable to the intervention while accounting for baseline differences between the groups.

Experimental Design with Pretests and Posttests

- **G1 (Experimental Group):** Pretest (O1) → Intervention (X) → Posttest (O2)
- **G2 (Control Group):** Pretest (O3) → No Intervention → Posttest (O4)

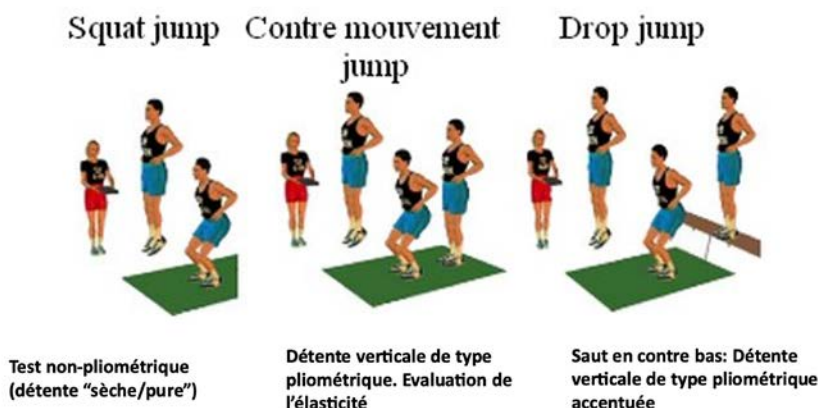
This design allows for a comparative analysis of performance improvements between the experimental and control groups.

1.2 Evaluation Tests

The evaluation includes tests to measure power and speed at predetermined intervals (beginning and end of the program).

- **Power Tests:**
 - Vertical jumps (e.g., Squat Jump, Countermovement Jump, Drop Jump).
- **Technical Speed Tests:**
 - Speed of specific taekwondo techniques (e.g., kicking or striking execution).

Evaluation des qualités de détente



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These tests aim to quantify changes in physical and technical attributes resulting from the training program.

Evaluation of Anaerobic Alactic Power

The vertical jump test, specifically the Squat Jump (SJ), is the most valid, well-documented, and verified method for assessing anaerobic alactic power (Bosco, 1980). The vertical leap is measured using the SJ, which evaluates starting power from a static position. It is considered a "dry" vertical jump, making it particularly important for assessing lower body explosive strength. In the SJ, there is no preparatory downward movement, meaning no "countermovement" is involved. Thus, the power generated in the SJ relies solely on the muscles' ability to produce force from a static position.

This test primarily assesses pure explosive strength without the assistance of muscle elasticity, focusing on the concentric force of the legs.

Countermovement Jump (CMJ):

In the CMJ, the athlete utilizes a rebound movement. During the downward phase, elastic energy is stored in the tendons and muscles, which is then released to increase power during the jump. The CMJ evaluates explosive power by integrating the use of the elastic energy from muscles and tendons, providing a broader assessment of explosive strength compared to the SJ.

Drop Jump (DJ):

The Drop Jump is the most representative test of plyometric ability. It involves more intense muscle tension and response compared to the CMJ. The DJ measures not only power but also muscular reactivity and the ability to absorb energy upon landing before rebounding.

The DJ is a specialized jump test that evaluates an athlete's ability to harness elastic energy to rebound after a drop. In other words, it measures muscular reactivity and elastic strength. This test is particularly useful for assessing the ability to perform rapid and forceful movements following a high-impact landing.

These three tests—SJ, CMJ, and DJ—complement each other in assessing different aspects of explosive strength:

- **SJ:** Pure concentric explosive strength.
- **CMJ:** Elastic and concentric explosive strength.
- **DJ:** Reactive and elastic explosive strength.

Together, they provide a comprehensive evaluation of an athlete's lower-body power and explosiveness.

Table 1: Characteristics of Jumps

Aspect	Squat Jump (SJ)	Countermovement Jump (CMJ)	Drop Jump (DJ)
Starting Position	Squatting without CMJ	Squatting with CMJ	Elevated drop from a platform
Stretch shorting cycle (SSC)	Not used.	Used.	Strongly used
Muscular power	Pure concentric	Explosive power with SSC assistance.	Relative and fast elastic power
Jump height	Generally lower than CMJ	Generally higher due to elasticity	Can be comparable or higher depending on reactivity
Performance measurement	Force without momentum elastic assistance	Power using momentum and elastic energy	Ability to use SSC for quick rebounding

TESTS SPECIFIQUES

Coups de pied avec l'élastique 15sec (pandal-chagui)



Frappe au sac 15sec (pandal-chagui)



Use of Elastic Resistance in Kick Testing

The use of elastic resistance for kick testing increases the level of resistance, requiring the leg muscles to sustain a constant effort. The athlete must maintain the speed of their kicks despite the resistance, highlighting their muscular explosiveness.

Punching Bag Test

The punching bag test evaluates the athlete's ability to deliver powerful and rapid strikes, simulating a real striking scenario. Performing a series of strikes over 15 seconds requires solid anaerobic capacity to resist muscular fatigue and good technique.

Training Program

- **Duration:** A 6-month macrocycle.
- **Frequency:** 3 weight training sessions per week.
- **Focus:**
 - Exercises targeting explosive strength in the lower body.
 - Includes jumps, squats, and plyometric exercises.

This program aims to enhance explosive power, endurance, and technique to improve overall performance in taekwondo athletes. Let me know if you need more details about the specific exercises or training structure.

Analysis and Interpretation of Results

The collected data will be analyzed using appropriate statistical methods to evaluate the impact of the strength training program on the athletes' power and technical skills. Pre- and post-intervention results will be compared to determine the program's effectiveness.

2. Results Analysis

2.1 Morphology: Height and Weight

Height and weight are critical anthropometric variables systematically measured in sports research.

Table 2: Descriptive Statistics

Variables	Taille GT	Taille GE	Poids GT	Poids GE
Moyenne	180,10	174,90	68,90	64,40
Ecart-type	6,30	3,35	7,82	7,93
Minimum	173	169	58	52
Maximum	192	180	87	74

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Figure 1: Average height and weight values (GT : control group ; GE : experimental group)

- The average height difference between the two groups is **5.20 cm**, with the control group being taller on average (Control Group: **180.10 cm**, Experimental Group: **174.90 cm**).
- The **t-test** analysis of the height variable shows a statistically significant difference between the two groups (**p-value = 0.033**), indicating that the groups cannot be considered equivalent in terms of height. This raises concerns about selection bias, as height differences may influence jump test performances.
- The control group also has a higher average weight than the experimental group. However, the difference between their mean weights is minimal, and statistical analysis confirms it is not significant (**p-value = 0.217**). This indicates that the observed weight differences are likely due to random variations rather than real effects of the measured variable.

2.2 Pretest Analysis Between the Control and Experimental Groups Pre-Intervention Measurements (Pretests):

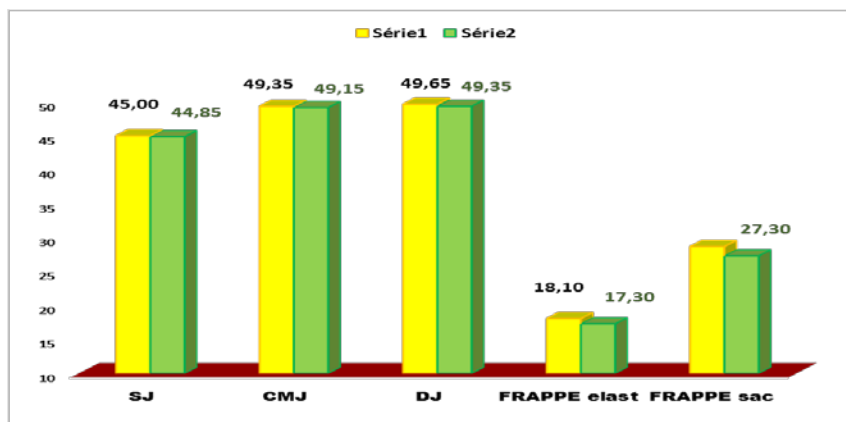


Figure 2: Histogram of mean pretest values for the control group (Series 1) and experimental group (Series 2)

The initial step involved analyzing pretest data to assess the baseline levels of the two groups and verify their equivalence before the intervention. This ensures that any observed post-intervention differences can be attributed to the training program.

- Comparing the mean performance of the two groups across all tests revealed no significant differences in their initial levels.
- This lack of significant differences indicates that the two groups started with similar skill levels, ensuring their comparability.

Verifying group equivalence at the pretest stage is crucial to avoid selection bias and confirm that post-intervention changes are genuinely caused by the training program. If the groups had significantly different baseline levels, attributing changes solely to the program would be challenging. By comparing the mean performance of the two groups for each test, it was observed that the differences between the means were not statistically significant. In other words, no significant differences emerged between the groups before the intervention, indicating that they shared a similar initial level of competence. The initial data provided by the pretests thus establish a reliable baseline for measuring the progress and potential impacts of the program. This allows us to infer that any improvement observed after the intervention is likely a direct result of the program rather than due to pre-existing differences between the groups.

However, it is important to note that this interpretation does not constitute absolute proof. It is impossible to fully control for confounding factors or

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external variables that might also influence the results. Therefore, while the findings strongly suggest the program's effectiveness, some degree of uncertainty remains due to potential uncontrollable influences.

2.3 Posttest Analysis Between the Control and Experimental Groups

The comparison of posttest results between the control and experimental groups aims to demonstrate the effectiveness of the training program. This stage evaluates the impact of the intervention on the experimental group relative to the control group.

Table 3 : Gain in % and p-value Calculated

Posttests	GE %		
SJ	5,05	0,349	ns
SJ E(w/kg)	4,04	0,069	(s* à p=0,10)
CMJ	8,60	0,036	s*
CMJ E(w/kg)	4,90	0,035	s*
DJ	1,72	0,380	ns
DJ E(w/kg)	6,96	0,010	s**
Frap E	4,95	0,140	ns
Frap S	3,77	0,258	ns

The analysis of posttest results shows that certain physical variables significantly improved following the intervention. The data indicate statistically significant improvements in the Countermovement Jump (CMJ) test and its associated power measurement (CMJ Power in w/kg), as well as in the Drop Jump (DJ) Power (w/kg) test. These results highlight the effectiveness of the program in enhancing explosive strength and power. While the improvements for the Squat Jump (SJ) and its associated power measurement (SJ Power in w/kg) were not statistically significant at the conventional 0.05 threshold, the observed p-values (0.349 for SJ and 0.069 for SJ Power) suggest a trend toward improvement, especially for power, where the **p-value below 0.10** indicates a noteworthy near-significant result.

The results indicate that there was no significant effect on the specific tests, although absolute improvements of **4.95%** and **3.77%** were observed in the striking tests. These improvements, however, remain statistically non-

significant. Similarly, the improvements observed in the Drop Jump (DJ) and specific tests were not significant, suggesting that the observed changes, while indicative of a trend toward improvement, were not substantial enough to reach statistical significance. The significance of relative power suggests that the training program succeeded in enhancing specific physical qualities relevant to taekwondo performance, even if these changes are not immediately reflected in broader performance tests.

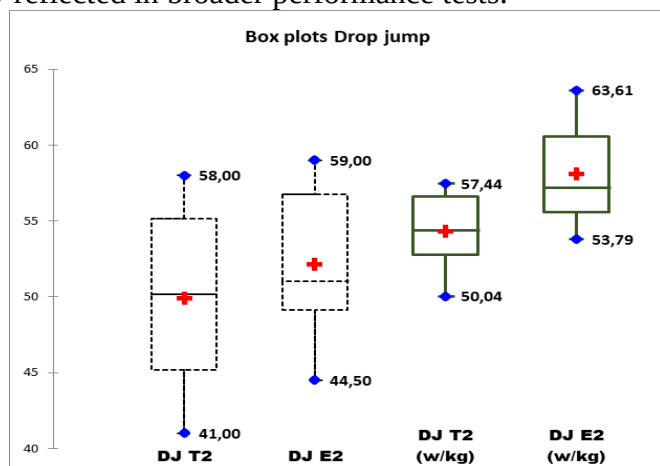


Figure 3 : Posttests of control group and experimental group

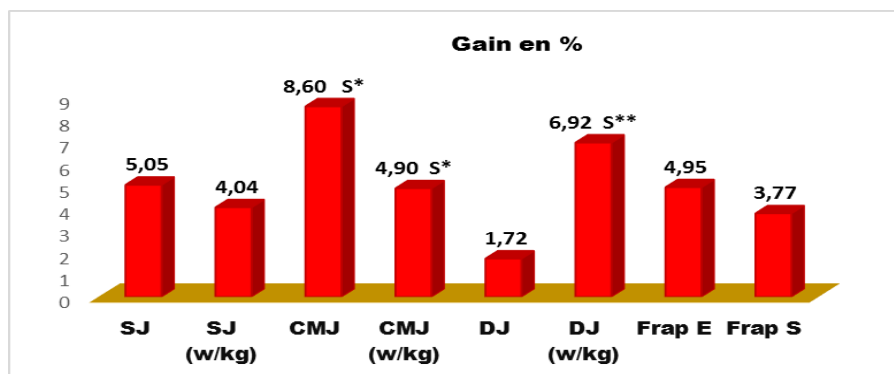


Figure 4 : Percentage gain in posttest results : experimental vs control group

The results clearly demonstrate that the program had beneficial effects on the key physical qualities tested. The taekwondo practitioners in the experimental group achieved significantly superior performances in certain tests and displayed higher absolute values in others.

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The program notably enhanced maximal explosive strength in the experimental group compared to the control group, which is a significant advantage for improving the physical potential of taekwondo athletes. This improvement in explosive strength is a critical component for executing powerful and effective techniques, underscoring the program's relevance and effectiveness in addressing the specific demands of the sport.

2.4 Analysis of Progression Rates (%) in Posttests

To evaluate the effectiveness of the training program, progression rates between pretests and posttests were analyzed within each group to assess internal evolution.

- **Within the Control Group:** To assess if significant changes occurred in the absence of the intervention program.
- **Within the Experimental Group**
To assess whether the specific training program resulted in significant improvements in performance metrics.

Variables	GT%	Pvalue	GE%	Pvalue
SJ	1,11	0,074 NS (s^* à $p=0,10$)	6,58	< 0,0001 S***
CMJ	1,13	0,011 S*	10,27	< 0,0001 S***
DJ	0,52	0,435 NS	5,67	< 0,0001 S***
Frap E	0,55	0,766 NS	10,40	< 0,0001 S***
Frap S	1,74	0,138 NS	10,99	< 0,0001 S***

The comparison of progression rates between the control group and the experimental group provides a clear picture of the program's effectiveness. By analyzing the evolution of each group's performance from pretests to posttests, we can better understand the impact of the intervention. The comparison reveals that the experimental group benefited significantly from the intervention program, particularly in explosive and relative power metrics. The control group, relying on standard training, showed minimal and statistically insignificant changes. This highlights the program's effectiveness in driving measurable performance gains.

1. Analysis of Squat Jump (SJ) Results

Control Group: Progression Rate: **1.11%** ; Not significant at the conventional threshold of **0.05**. The control group exhibited minor

improvements, likely due to natural variability or the effects of regular training. However, these changes were not substantial enough to be statistically significant under conventional thresholds.

Experimental Group: Progression Rate: **6.58%**; Highly significant ($p < 0.05$).

The experimental group achieved a notable and statistically significant improvement in the Squat Jump test. This reflects the effectiveness of the intervention program in enhancing concentric explosive strength, a key component assessed in the Squat Jump.

The **experimental group** outperformed the **control group** significantly in the Squat Jump test, with a progression rate nearly six times higher.

The intervention program's focus on explosive strength exercises directly contributed to the observed improvement in the experimental group. The results highlight the significant impact of the intervention program on the Squat Jump test, demonstrating its ability to effectively enhance explosive strength. In contrast, the control group's minimal improvement underscores the limited benefits of routine training alone.

2. Analysis of Countermovement Jump (CMJ) :

Control Group: Progression Rate: **1.13%** ; Statistically significant ($p < 0.05$).

The control group displayed a small but significant improvement in the CMJ test, suggesting that regular training might contribute to marginal gains in this area.

Experimental Group: Progression Rate: **10.27%** ; Highly significant ($p < 0.01$).

The experimental group showed a substantial and statistically significant improvement in CMJ performance. This indicates that the intervention program significantly enhanced explosive power, particularly through the utilization of elastic energy stored during the countermovement phase.

The **experimental group's** progression rate (**10.27%**) is markedly superior to that of the **control group** (**1.13%**). The large improvement in the experimental group underscores the program's effectiveness in targeting and enhancing elastic-concentric explosive strength, which is critical for CMJ performance.

The intervention program led to a significant enhancement in CMJ performance for the experimental group, far surpassing the modest gains

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observed in the control group. This highlights the program's targeted impact on the explosive and elastic strength required for optimal performance in dynamic movements like the Countermovement Jump.

3. Analysis of Drop Jump (DJ) Results

Control Group: Progression Rate: **0.52%** ; Not statistically significant ($p > 0.05$).

The control group did not show any meaningful improvement in the Drop Jump test. The minimal progression indicates that regular training was insufficient to enhance reactive and elastic strength, key components measured in this test.

Experimental Group: Progression Rate: **5.67%** ; Statistically significant ($p < 0.05$).

The experimental group achieved a significant improvement in Drop Jump performance, reflecting the program's effectiveness in developing reactive and elastic explosive strength, which is crucial for movements requiring rapid force production following a landing.

The experimental group's progression rate (**5.67%**) far exceeded the control group's (**0.52%**), highlighting the clear impact of the intervention program. The focus on plyometric and elastic strength exercises in the training program likely contributed to the significant gains in reactive strength observed in the experimental group.

The intervention program successfully improved the experimental group's Drop Jump performance, with significant gains in reactive and elastic power. The lack of meaningful improvement in the control group further emphasizes the necessity of targeted training for enhancing this specific physical quality.

4. Analysis of Striking Test with Elastic Resistance

Control Group: Progression Rate: **0.55%** ; Not statistically significant ($p > 0.05$).

The control group did not exhibit any meaningful improvement in this test. The negligible progression indicates that routine training had no measurable impact on the ability to generate striking power under elastic resistance.

Experimental Group: Progression Rate: **10.40%** ; Highly significant ($p < 0.01$).

The experimental group demonstrated a substantial and statistically significant improvement in striking power with elastic resistance. This result

underscores the effectiveness of the intervention program in enhancing muscular explosiveness and strength endurance, which are critical for maintaining striking speed and power under resistance.

The training program significantly improved the experimental group's performance in the striking test with elastic resistance, demonstrating its effectiveness in developing explosive strength and resistance to fatigue in dynamic striking movements. The lack of improvement in the control group highlights the necessity of a structured and targeted approach to training for this specific skill.

5. Analysis of Striking Test on the Bag

Control Group: Progression Rate: **1.74%**. ; Not statistically significant ($p > 0.05$).

The control group showed no significant improvement in this test. The minimal progression suggests that routine training had little to no impact on enhancing striking power and endurance during the bag test.

Experimental Group: Progression Rate: **10.99%** ; Highly significant ($p < 0.01$).

The experimental group displayed a substantial and statistically significant improvement in striking performance. This improvement reflects the effectiveness of the training program in increasing muscle power, speed, and endurance, essential for executing rapid and powerful strikes over an extended period.

The experimental group's progression rate (**10.99%**) far exceeded the control group's (**1.74%**), highlighting the effectiveness of the intervention program in enhancing striking performance. The significant improvement in the experimental group is likely due to the program's focus on developing anaerobic capacity, explosive strength, and technical precision, all of which are crucial for this test.

The intervention program significantly improved the experimental group's striking performance on the bag, with a highly significant progression rate of **10.99%**. This demonstrates the program's efficacy in enhancing key physical and technical attributes for striking, while the control group's negligible progression underscores the limitations of routine training in achieving similar results. The method allowed us to quantify the impact of the training program and gain a deeper understanding of its specific effects. The analysis of percentage gains clearly demonstrates that the experimental

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group achieved far greater improvements compared to the control group. The specific training program that was implemented appears to have had a highly significant impact on the progression of the experimental group. This result underscores the program's effectiveness in enhancing key physical and technical attributes, as evidenced by the marked differences in progression rates across various tests. The findings validate the value of targeted and structured interventions in optimizing performance, particularly in the context of taekwondo, where explosive power and technical precision are critical for success.

Conclusion:

The aim of this study was to evaluate the impact of a training program on the power qualities of taekwondo athletes. A quasi-experimental design was adopted, enabling a comparison of posttest results between the experimental and control groups to assess the overall effectiveness of the training program. Additionally, analyzing each group's evolution from pretest to posttest allowed us to observe their respective improvements over time. The study confirmed the efficacy of the training program in enhancing power qualities among taekwondo athletes. The three-step analysis provided comprehensive insights into:

1. Initial equivalence of the groups.
2. The significant impact of the program on the experimental group.
3. The stark contrast in progression rates, highlighting the program's superiority over routine training.

These findings validate the program as an effective approach to developing explosive strength and technical precision in taekwondo athletes. The evolution of modern training emphasizes the growing importance of explosive qualities in combat athletes. The evaluation of physical attributes increasingly focuses on parameters such as power, strength, and speed.

Our working hypothesis, which proposed that a strength training program specifically tailored to the practice of taekwondo would enhance power, is supported by our results. The findings demonstrate the effectiveness of such a program in improving key performance metrics. The development of power, particularly explosive strength and vertical leap should be a primary objective in the training regimen of every taekwondo practitioner. These qualities are essential for executing dynamic and effective techniques, ultimately contributing to improved competitive performance. This study

reinforces the critical role of targeted training strategies in optimizing athletic potential in taekwondo. The results clearly demonstrate that the training program had a beneficial impact on the key physical qualities tested. The taekwondo athletes in the experimental group achieved significantly superior performances compared to the control group. The analysis of progression rates within each group, as well as the posttest performance comparisons, highlights that the program led to substantial improvements in the experimental group's physical potential, particularly in strength endurance. This improvement represents an undeniable advantage as strength endurance is a critical performance criterion in taekwondo, where maintaining power and explosiveness over time is essential for success in combat. These findings confirm the effectiveness of the tailored program in enhancing the physical attributes necessary for competitive taekwondo. We can affirm and conclude that the evolution of modern training emphasizes the increasing importance of explosive qualities in combat sports. The assessment of physical attributes now focuses on key parameters such as power, strength, and speed. The training of explosive strength and vertical leap, whether conducted separately or integrated into technical preparation, has become indispensable and essential in the preparation of taekwondo athletes. It represents a crucial step for achieving progress and optimizing performance in competition. This study underscores the necessity of incorporating targeted power training into modern taekwondo preparation to meet the demands of the sport and enhance athletes' competitive edge.

Bibliography :

- Cometti.G (1988), la pliométrie, UFR STAPS, université de bourgogne, Dijon cedex.
- Kotzamanidis, (2006), effet de l'entraînement pliométrique sur les performances.
- Bosco, C. (1985). Élasticité du muscle squelettique humain dans les sauts verticaux. *European Journal of Applied Physiology*, 54(4), 389-393.
- Bosco, C., & Komi, P. V. (1979). Caractéristiques mécaniques et composition des fibres des muscles extenseurs de la jambe humaine. *European Journal of Applied Physiology*, 41(4), 275-284.
- Bosco, C., Luhtanen, P., & Komi, P. V. (1983). Une méthode simple pour mesurer la puissance mécanique dans les sauts. *European Journal of Applied Physiology*, 50(2), 273-282.
- Komi, P. V., & Bosco, C. (1978). Utilisation de l'énergie élastique stockée dans les muscles extenseurs de la jambe par les hommes et les femmes. *Medicine and Science in Sports*, 10(4), 261-265.
- Bobbert, M. F., Gerritsen, K. G. M., Litjens, M. C. A., & Van Soest, A. J. (1996). Pourquoi la hauteur du saut avec contre-mouvement est-elle plus élevée que celle du squat jump ? *Medicine & Science in Sports & Exercise*, 28(11), 1402-1412
- Cheramy Maxime (2017) : Test de Bosco, Bases de condition physique, Editions Vigot, Paris