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Original article. Effects of training intensity and utilization on the validity of physical performance tests: a gender-based analysis. Vol. 12, n. º 3; p. 1-15, July 2026. https://doi.org/10.55040/s9km2e63

# Effects of training intensity and utilization on the validity of physical performance tests: a gender-based analysis

# Efectos de la intensidad del entrenamiento de equipo y utilización en la validez de las pruebas de rendimiento físico: un análisis basado en el género

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**Resumen**
Los componentes físicos como la potencia y la agilidad son elementos cruciales en el rendimiento atlético, pero la influencia de la intensidad del entrenamiento y las diferencias de género en la adaptación a ambos aún varían. Este estudio tiene como objetivo examinar el efecto de la intensidad del entrenamiento (60% vs. 90%) y el género en la potencia y la agilidad. El método de investigación involucró a 52 sujetos (26 hombres y 26 mujeres, de 19 a 22 años) que se dividieron en cuatro grupos según la intensidad. El programa de entrenamiento utilizó el método de escuadrón y utilización durante 8 semanas con una frecuencia de 3 veces por semana. Los instrumentos de medición incluyeron la Prueba de Obstáculos Hexagonales, la Prueba de Agilidad de Illinois, la Prueba de Triple Salto y la Prueba de Salto Vertical. Los resultados mostraron que en los hombres, el 60% de intensidad fue suficiente para mejorar la agilidad simple y la potencia horizontal. Por el contrario, las mujeres requirieron una intensidad del 90% para lograr mejoras significativas en ambas variables. Para la potencia vertical, se requirió una intensidad del 90% tanto para hombres como para mujeres. Sin embargo, ninguna intensidad tuvo un efecto significativo en la agilidad compleja en ninguno de los dos géneros. En conclusión, la adaptación física está influenciada por la intensidad y el género, siendo las mujeres las que tienden a requerir mayores estímulos para reclutar de forma óptima las fibras musculares tipo II.
**Palabras Clave:** potencia, agilidad, intensidad del ejercicio, género

**Abstract**
Physical components such as power and agility are crucial elements in athletic performance, but the influence of exercise intensity and gender differences on adaptation to both still vary. This study aims to examine the effect of exercise intensity (60% vs. 90%) and gender on power and agility. The research method involved 52 subjects (26 men and 26 women, aged 19–22 years) who were divided into four groups based on intensity. The exercise program used the squad and utilization method for 8 weeks with a frequency of 3 times per week. Measurement instruments included the Hexagonal Obstacle Test, Illinois Agility Test, Triple Hop Test, and Vertical Jump Test. The results showed that in men, 60% intensity was sufficient to improve simple agility and horizontal power. Conversely, women required 90% intensity to achieve significant improvements in both variables. For vertical power, 90% intensity was required for both men and women. However, no intensity had a significant effect on complex agility in either gender. In conclusion, physical adaptation is influenced by intensity and gender, with women tending to require higher stimuli to optimally recruit type II muscle fibers.
**Keywords:** power, agility, exercise intensity, gender

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## Introduction

Physical components such as power and agility are crucial elements in achieving sports performance, including in martial arts like taekwondo (Bompa & Buzzichelli, 2022). Power is the ability to generate force quickly in a short period of time and is physiologically related to the recruitment of fast-twitch muscle fibers triggered by intense exercise stimuli and maximal contraction patterns (Ferrini et al., 2025). Meanwhile, agility is the ability to quickly and efficiently change the direction, position, and orientation of the body in response to external stimuli, which is heavily influenced by neuromuscular coordination and muscle reflex responses (Shiraz et al., 2024).

Power, speed, and agility are fundamental attributes that significantly influence athletic performance across various sports (Negra et al., 2016). Developing muscle mass is crucial to support explosive movements and generate the explosive power required for performance (Ramos et al., 2025). Agility can significantly improve an athlete's physical abilities, including change of direction speed and reactive response to environmental stimuli, which contributes to improved performance (Sun et al., 2025).

The development of these physical components is influenced by the intensity of the exercise (Zhou et al., 2024). Principles of exercise physiology explain that adaptation of muscles, energy systems, and motor skills is significantly influenced by the specific adaptation to imposed demands (SAID) principle and the overload principle (Davison et al., 2022). High-intensity exercise tends to stimulate increased neuromuscular capacity and anaerobic metabolism, which directly impacts power capacity and the ability to react quickly and change body direction (Kızılca et al., 2026).

An intensive exercise program over a period of 7–8 weeks can significantly increase explosive leg muscle power and multidirectional agility compared to other exercise methods (Hu et al., 2025). Recommended exercise intensity is in the range of 60–90% of maximum capacity (Franklin et al., 2022). An intensity of 60% is often associated with developing aerobic baseline and submaximal strength, while an intensity of 90% stimulates type II (fast-twitch) muscle fibers, which play a key role in explosive power and speed (Stone et al., 2022). High-intensity exercise models have a more maximal effect than moderate-intensity exercise in influencing physiological changes in the body (Hadiono et al., 2025).

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In addition to intensity, the development of power and agility exercise models also differs between men and women athletes. Scientific studies show that physical performance is influenced by different biological factors in men and women, including muscle structure, hormones, and body composition (Mahapatra & Abhinandan, 2023). Men athletes tend to demonstrate higher power and explosive performance than women athletes, which is physiologically related to greater muscle mass and the more dominant influence of testosterone in men (Handelsman et al., 2018). Recent observational studies also report statistically significant differences in agility levels between men and women, with men generally performing higher on standardized agility tests (Chattanta et al., 2024).

Although scientific evidence demonstrates a link between exercise intensity and improved physical performance, research findings vary widely regarding the extent to which intensity affects each component of power and agility. Several meta-reviews have shown positive results, but further research is recommended to understand the specific adaptation mechanisms based on variations in exercise intensity, duration, and volume (Wang et al., 2025).

Therefore, this study will examine in more depth the influence of exercise intensity and gender on power and agility in physical performance to provide a strong scientific basis for coaches and athletes in developing more effective, safe, and evidence-based exercise programs.

## Methodology

*Subjects*

This study used 26 men and 26 women with an average age of 19-22 years. All subjects were divided into 4 groups. The 90% men group (n=13) was given 90% intensity exercise, the 60% men group (n=13) was given 60% intensity treatment. Meanwhile, the 90% women group (n=13) was given 90% intensity treatment and the 60% women group (n=13) was given 60% intensity treatment.

*Exercise Training Protocol*

The exercise program in this study used the squad and utilization exercise method. Ninety percent of the men and women groups were given squad and utilization exercise

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at 90% intensity. Sixty percent of the men and women groups were given squad and utilization exercise at 60% intensity. Exercise was conducted three times per week for a total of eight weeks.

*Measurement*

Simple agility with rapid changes of direction was measured using the Hexagonal Obstacle Test. Complex agility was measured using the Illinois Agility Test. Horizontal leg power was measured using the Triple Hop Test and vertical leg power using the Vertical Jump Test.

*Statistical Analysis*

Initial data processing used descriptive statistics to obtain an overview of the average results for each variable. Normality was tested using the Shapiro-Wilk test. Homogeneity was tested using the Levene test. Furthermore, differences in power and agility between exercise intensity and gender were tested using ANOVA.

## Results

The results of the measurements in each intensity and gender group between the pre-test and post-test show the results as in Table 1 and Table 2.

**Table 1.**
Average men power and agility results

| Variable | 90% Intensity | | 60% Intensity | |
|---|---|---|---|---|
| | Pre | Post | Pre | Post |
| Simple agility (*Hexagonal Obstacle Test)* | 14.3 | 12.9* | 15.2 | 13.1* |
| Complex agility (*Illinois Agility Test)* | 17.66 | 17.88 | 18.12 | 15.59 |
| Horizontal leg power (*Triple Hop Test)* | 576 | 608* | 588 | 619* |
| Vertical leg power (*Vertical Jump Test)* | 53.2 | 57.4* | 51 | 51.25 |

*There is a significant difference between the pre-test and post-test with a significance level of $P<0.05$.

Table 1 shows a difference in simple agility exercise at 90% and 60% intensity, indicating that both intensities significantly improved simple agility. However, there was no difference in complex agility exercise between 90% and 60% intensity.

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Horizontal leg power exercise at 90% and 60% intensity had a significant effect in men. Meanwhile, vertical leg power exercise only affected men at 90% intensity, while exercise at 60% intensity had no effect.

**Table 2.**
Average men power and agility results with 90% and 60% intensity

| Variable | Intensity | |
|---|---|---|
| | 90% | 60% |
| Simple agility (*Hexagonal Obstacle Test)* | 12.9 | 13.1 |
| Complex agility (*Illinois Agility Test)* | 17.88 | 15.59 |
| Horizontal, leg power (*Triple Hop Test)* | 608 | 619* |
| Vertical leg power (*Vertical Jump Test)* | 57.4 | 51.25* |

*There is a significant difference between 90% and 60% intensity with a significance level of P<0.05

Tables 1 and 2 show the results of the power and agility test for men trained at 90% and 60% intensity. Simple agility at 90% and 60% intensity were equally effective for men, and there was no significant difference between 90% and 60% exercise. For complex agility, both intensities did not show a significant effect. Horizontal leg power at 90% and 60% intensity exercise was equally effective, and there was no difference between the two intensities. Meanwhile, for vertical leg power, only 90% intensity was effective; 60% intensity did not show a significant effect for men.

**Table 3.**
Average women power and agility results

| Variable | 90% Intensity | | 60% Intensity | |
|---|---|---|---|---|
| | Pre | Post | Pre | Post |
| Simple agility (*Hexagonal Obstacle Test)* | 16.2 | 14.3* | 16.2 | 15.6 |
| Complex agility (*Illinois Agility Test)* | 19.60 | 18.76 | 19.57 | 18.91 |
| Horizontal leg power (*Triple Hop Test)* | 472 | 502* | 471 | 482 |
| Vertical leg power (*Vertical Jump Test)* | 43.3 | 50.4* | 43.6 | 45.8 |

*There is a significant difference between the pre-test and post-test with a significance level of P<0.05.

Table 3 shows that there was a difference in simple agility exercise at 90% intensity, while 60% intensity showed no significant effect in women. There was no

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difference in complex agility exercise between 90% and 60% intensity exercise in women.

For horizontal leg power, 90% intensity exercise had a significant effect in women. Meanwhile, only 90% intensity exercise had an effect on vertical leg power in women, while 60% intensity exercise had no effect.

**Table 4.**
Average women power and agility results with 90% and 60% intensity

| Variable | Intensity | |
|---|---|---|
| | 90% | 60% |
| Simple agility (*Hexagonal Obstacle Test)* | 14.3 | 15.6* |
| Complex agility (*Illinois Agility Test)* | 18.76 | 18.91 |
| Horizontal leg power (*Triple Hop Test)* | 502 | 482* |
| Vertical leg power (*Vertical Jump Test)* | 50.4 | 45.8* |

* There is a significant difference between 90% and 60% intensity with a significance level of $P<0.05$

Tables 3 and 4 show the results of the power and agility test for women trained at 90% and 60% intensity. For simple agility, exercise at 90% intensity significantly improved results for women compared to exercise at 60%. For complex agility, both intensities did not show a significant effect. Horizontal leg power exercise at 90% intensity was more effective for women than exercise at 60%. Meanwhile, only 90% intensity had an effect on vertical leg power, while 60% intensity did not show a significant effect for women.

## Discussion

*Simple Agility*

The results of the study showed that simple agility skills tested using the Hexagonal Obstacle Test were effective in the men group at both 90% and 60% exercise doses, while the women group was only effective at 90%. This finding provides an interesting insight into differences in physiological adaptation responses based on gender and exercise dose. In men, moderate exercise doses (around 60% of maximum capacity) were sufficient to improve neuromuscular coordination, a key component in simple movement pattern-based agility tests like the hexagonal obstacle test (Wendt et al., 2022). This aligns with motor learning theory, which emphasizes that coordination can develop

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significantly when stimuli are provided consistently, even at lower intensities (Rong et al., 2025).

Meanwhile, in women, significant improvements only emerged at the higher dose (90%). This difference can be explained by physiological factors, particularly muscle fiber composition. Women generally have a higher proportion of type I muscle fibers than men, requiring higher exercise intensities to optimally recruit type II muscle fibers (Landen et al., 2021). Therefore, a 90% exercise stimulus can provide sufficient stress to force the neuromuscular system to adapt, resulting in improved agility performance (Hung et al., 2025).

This finding also aligns with the principle of specific adaptation to imposed demands (SAID principle), which states that the body adapts according to the type and intensity of the applied load. For men, moderate doses are specific enough to stimulate coordination, while in women, adaptive demands are only reached when the load reaches a higher level (Cenizo-benjumea et al., 2022).

*Complex Agility*

The results showed that neither group experienced significant improvement on the Illinois test, for either men or women, with either 60% or 90% exercise doses. This is interesting to analyze because the Illinois Agility Test is considered a gold standard for measuring complex agility (Makhlouf et al., 2022). This test not only requires rapid changes of direction but also involves acceleration and deceleration phases, as well as the ability to regulate movement rhythm over a longer distance than simple agility tests such as the hexagonal obstacle course. Therefore, the Illinois test demands a combination of linear speed, coordination, and reactive agility, rather than just basic neuromuscular abilities (Pancar et al., 2025).

Complex agility requires more specific and structured exercise, typically with a sport-specific drill-based approach and longer durations to demonstrate significant improvement (Söyler, 2022). In the context of this study, exercise programs administered at 60% or 90% intensity levels likely failed to provide a sufficiently profound stimulus to impact the complex agility components measured in the Illinois Test. This suggests limitations in the transfer of general exercise results to improved performance on multidimensional agility tests.

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Adaptations to these abilities generally require exercise programs focused on change-of-direction drills, multidirectional plyometrics, and visual or auditory reaction speed-based exercise (Sinkovic et al., 2023). Repetition-based exercise alone, as used in this study, appears insufficient to produce significant improvements.

*Horizontal Leg Power*

The results showed that exercise at 90% and 60% intensity had an effect on men, while exercise at 90% intensity was effective in women. This finding provides an interesting insight into differences in exercise adaptation based on gender and intensity. This can be explained by the theory that men generally have a higher percentage of type II muscle fibers (fast-twitch fibers) than women (Haizlip et al., 2015). Type II fibers are more responsive to moderate to high-load stimuli, so even when exercise at only 60% of maximal capacity, the neuromuscular adaptations that occur are sufficient to increase horizontal explosive ability (Olsen et al., 2025).

In women, significant improvements were only seen when the exercise dose reached 90%. This finding also aligns with previous research that found high-dose exercise to be more effective in increasing power capacity in young women than moderate-dose exercise (Campillo et al., 2014). This can occur because there are possible differences in muscle mass and body composition, thus differentiating the thrust between men and women, which can affect power strength (Haag & Weyand, 2025).

*Vertical Leg Power*

The results showed that significant increases in vertical leg power only occurred at a 90% exercise dose, in both men and women. This finding is highly relevant to exercise physiology theory, which explains that vertical jump ability is heavily influenced by the recruitment of type II muscle fibers (fast-twitch fibers), which have the capacity for rapid and powerful contractions (Aslam et al., 2025). These fibers cannot be optimized with light to moderate exercise doses and instead require a high-intensity stimulus to activate their maximal contraction potential (Plotkin et al., 2021).

In men, while a moderate dose (60%) was quite effective in increasing horizontal power (triple hop), this was not the case for vertical power. In women, the same trend was observed. Only exercise at a 90% dose resulted in significant increases in vertical jump. This finding also supports the principles of specificity and overload in exercise

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theory. This is consistent with the fact that women generally have a higher proportion of type I muscle fibers, so a submaximal stimulus (60%) is not challenging enough to predominantly recruit type II muscle fibers. With high-dose exercise, adaptations in the form of increased explosive power can occur, although the rate of development tends to be slower than in men (Roberts et al., 2020).

## Conclusion

Squad exercise and 60% utilization can improve simple agility performance and horizontal leg power in men, by integrating strength, balance, speed, agility, fatigue resistance, and plyometric training (Feng & Liu, 2026)**.** Meanwhile, women require 90% intensity to achieve simple agility performance and horizontal leg power. In both men and women, there was no effect of 90% and 60% intensity on complex agility performance. For vertical leg power performance, 90% intensity is required for both men and women to achieve maximum results. The results of this study can be used as recommendations for coaches in determining gender-specific exercise intensity to achieve maximum performance. Future research is needed to examine other types or models of exercise to obtain more comprehensive results in improving athlete performance.

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