Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

The Effect of Weight Training on The Push Index and Achievement of the 400m Freestyle Over 20 Years

Firas Jaseb Khalaf [1], Moayad Jasem Abbas [2], Ehab Dakhel Hussein [3]

[1,2,3] University of Baghdad, College of Physical Education and sport sciences.

DOI:
https://doi.org/10.37359/JOPE.V38(2)2026.2258

Article history: Received 26/ February/2025 Accepted 10/ March /2025 Available online 28/ June/2026

Abstract

The study aimed to prepare exercises for men's 400-meter freestyle runners and to identify the mechanical variables of the thrust index, and the achievement of the research sample, and to identify the effect of weightlifting exercises on the thrust index and the achievement of the men's (400m) freestyle runner between the test (pre-post-test) of the research sample. The researcher hypothesized that statistically significant differences would exist between the pre- and post-tests in favor of the post-test for both the kinematic variable (propulsive index) and performance achievement in the research group. The research population consisted of track and field athletes specializing in the 400-meter event in Maysan Governorate during the 2023 sports season, totaling five (5) runners who competed in championships organized by the Iraqi Athletics Federation. The researcher recommended the use of weighted training exercises due to their effective role in developing muscular strength and subsequently improving athletic performance. The study also recommended utilizing the findings and generalizing them to speed runners, particularly those specializing in the 200-meter event, across all age categories. The researcher concluded that the designed training program using weighted exercises had a significant positive effect on both the propulsive index and performance achievement.

Keywords: Weighted Exercises, Propulsive Index, Performance, 400 m Running.

[1] University of Baghdad, College of Physical Education and sport sciences.
firas.harbi2204p@coope.uobaghdad.edu.iq
[2] University of Baghdad, College of Physical Education and sport sciences.
moaid.salman@cope.uobaghdad.edu.iq
[3] University of Baghdad, College of Physical Education and sport sciences.
Ihab.Yousif@cope.uobaghdad.edu.iq

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Introduction

Scientific progress in the modern era has become a major concern for researchers and specialists aiming to achieve the highest levels of performance across various fields of life. Despite continuous development, further scientific research is still required to uncover new facts and identify the most effective methods and techniques for improving athletic performance in sports activities. Achieving high performance in sports requires optimizing time and effort while ensuring correct movement pathways that correspond to the specific demands of the practiced event. Therefore, specialists and researchers in the field of sports science have placed considerable emphasis on solving problems that face athletic performance and promoting the advancement of sports through scientifically controlling the components of training load, including intensity, volume, and rest. The activities of the sprint race, including (400 meters), have their own physical characteristics that should be enjoyed by short-distance runners, that the development of these characteristics must be done in accordance with the requirements of the achieved achievement, and that the mechanical variables have a role in improving the achievement, through which an important role emerges in achieving the optimal start and reaching the maximum speed, during the stages of the technical performance of the men's 400 m freestyle event. Thus, the importance of research is evident in studying the effect of weight training on the development of some kinematic variables (thrust index) by working on the development of these variables and the reflection of the development of these variables on achievement.

Research Methodology

Depending on the background of the research, being one of the Iraqi champions in this event, he noticed the stability of the level of achievement among our runners in the local championships, as the researcher sees the reason for this decrease in the level to the absence of some of the pillars on which the development of physical and mechanical abilities is based, as he developed the idea of solving these problems, and after presenting this idea to the supervisors, the research concluded by using weight exercises to develop the development of the push and achievement index of the 400m freestyle

Research Population and Sample

The research population consists of (15) players from Iraq for the men's 400m freestyle event, and the researcher selected his research sample from Missan Governorate for the Iraqi clubs by the (5) players in the deliberate way, which ranged from (20-26) years, and accordingly, the sample constituted (33%), The homogeneity of the study sample was done in the measurements of

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

height, weight, chronological age and training age, and as shown in Table (1), the sample did not apply a similar training curriculum, and no other research was applied during this period.

Table 1. ***Shows the Homogeneity of the Research Sample in Anthropometric Measurements and Training Age***

Variables	N	Mean	Standard Deviation	Skewness Coefficient
Height (cm)	5	178.80	5.586	-0.727
Weight (kg)	5	71.80	12.377	-0.501
Age (years)	5	25.20	3.899	0.805
Training age (months)	5	10.60	2.191	0.846

Tests Used in the Study

1- Test 250m Bearing Speed

400 m Running Test

Purpose: To measure **speed endurance** performance.

Equipment: Standard athletics track (400 m) Three stopwatches Recording forms Two whistles

Performance Description: The athlete assumes the starting position behind the starting line. Upon hearing the whistle signal from the race organizer, the athlete begins running at maximum possible speed until reaching the finish line.

Recording Method: Time is recorded from the starting signal until crossing the finish line. The final result is calculated as the average time of the three timekeepers, recorded to the nearest **0.01 second**.

2. 350 m Running Test

Purpose: To measure **specific endurance performance**.

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Equipment: Athletics track (400 m) Three stopwatches Whistles Recording sheets

Performance Description: The athlete starts from a high-start position and runs at maximum speed until completing the specified distance.

Recording Method: Time is recorded in seconds and fractions of seconds, calculated as the average of the three recorded times to the nearest **0.01 second**.

Pilot Study

A pilot experiment was conducted on **Tuesday, June 11, 2024**, during which the 400 m running test was filmed using video cameras for biomechanical analysis. The race distance was divided into equal segments of **100 meters**, and each segment was further divided into two equal sections of **50 meters**. Cones or markers were placed at each 50-meter point. The camera was positioned perpendicular to the midpoint of the 100-meter distance to ensure accurate capture of movement variables. The purpose of dividing the distance into smaller segments was to measure biomechanical changes in stride characteristics during running. After reviewing the pilot recordings, the researcher observed that filming from the midpoint of 100 meters did not provide sufficient clarity for motion analysis. Therefore, the distance was divided into **50-meter segments** to improve measurement accuracy. Following the completion of the training program designed by the researcher using **weighted exercises according to target time**, post-tests were conducted between: **September 3, 2024 – September 5, 2024**The testing sequence was identical to the pre-test conditions and conducted under the same environmental and procedural conditions for all participants.

Table 2. *shows the details of the training curriculum*

Variable	Description
Number of weeks	8
Training units per week	3
Total training units	24
Duration of main part of session	30–40 minutes
Weekly training time	90–120 minutes

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Monthly training time	360 minutes
Total program duration	2,880 minutes
Average exercises per session	8–12 exercises
Total exercises in program	72 exercises

Results

In order to be able to identify the difference in the results of the pre- and post-tests of the members of the experimental research group in some kinematic variables, the researcher used a t-test for a single sample with a pre- and post-test, as shown in Table (3).

Table 3. *shows the arithmetic medians, standard deviations and the calculated value (t) of the pre-post-tests of the variable (thrust index m/s) for the research sample.*

Player	Unit	Pre-test Mean (M)	Pre-test SD	Post-test Mean (M)	Post-test SD	Mean Difference	SD Difference	Standard Error of Mean Difference	t-value	Error Level	Significance
Player 1	m/s	0.0113	0.00301	0.0075	0.0017	0.00375	0.00719	0.00180	2.087	0.054	Significant
Player 2	m/s	0.0288	0.00328	0.0156	0.00223	0.01313	0.00873	0.00218	6.012	0.000	Significant
Player 3	m/s	0.0250	0.00316	0.0137	0.00221	0.01125	0.00806	0.00202	5.582	0.000	Significant
Player 4	m/s	0.0206	0.0053	0.0144	0.0034	0.00625	0.01408	0.00352	1.775	0.096	Significant
Player 5	m/s	0.0175	0.00403	0.0113	0.00221	0.00625	0.01258	0.00315	1.987	0.066	Significant

Table 4. *shows the arithmetic means, standard deviations and the calculated value (t) of the pre-post-test tests (250 m speed tolerance, 350 m performance tolerance, 400 m achievement)*

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Variable	Unit	Pre-test Mean (M)	Pre-test SD	Post-test Mean (M)	Post-test SD	Mean Difference	SD Difference	Standard Error of Mean Difference	t-value	Error Level	Significance
250 m	m/s	28.32	1.401	28.14	1.399	0.208	0.06648	0.02973	6.996	0.002	Significant
350 m	m/s	44.00	1.079	43.94	1.023	0.146	0.1078	0.04823	3.027	0.000	Significant
400 m	m/s	49.60	0.9063	49.41	0.8704	0.194	0.06309	0.02821	6.876	0.002	Significant

Discussion

The impulse index of the first player (2.087) the second player (6.012) the third player (5.582) the fourth player (1.775) the fifth player (1.987) while the real morale of the sample members for the first player was (0.054) the second player (0.00) the third player (0.00) the fourth player (0.096) and the fifth player was .066) at a significance level less than or equal to (0.05) and a degree of freedom (4) and since the value of the significance of the calculated differences is less than the level of (0.05), then there are significant differences between the pre- and post-tests in the variable of foot thrust and in favor of the post-test. The development in this variable is the result of the exercises used, which were prepared to develop special force endurance, speed endurance and performance endurance, as it had an effective effect on stimulating the central nervous system, which in turn developed neural signals and created a kind of arousal in the muscle groups working positively, and in turn, it results in high stimulation of the muscle fibers working with maximum energy to accomplish the required work by exerting instantaneous explosive force calculated in a very short time. From the point of view of athletic training, the exercises used as resistance exercises are added to the body and in the direction of physical development, as it is stated (Kurz., 2001, p. 18) that "these exercises, which were applied during the main training period, worked to reduce the time of arousal and with the development of temporal and spatial timings according to the motor properties."

This is proven by the results of the differences in the above table, as it is clear from Table (3) that the calculated t-value for the (250 meters) test was (6.996) while the real significance of the (250 meters) test was (.002) at a lower significance level equal to (0.05) and a degree of freedom (4), and since the significance value of the calculated differences is less than the level of (Therefore, there are significant differences between the pre- and post-tests in the speed endurance variable of the 250-meter test and in favor of the post-test due to the use of weightlifting exercises according to the target time, which requires exerting the force of rapid muscle contractions for a period of time continuously during running, which developed the ability of the muscles to exert

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

force effectively and quickly, and this was evident through the appearance of significant differences in the level of speed endurance in the post-test, it gives an indication of the development and exertion of instantaneous force. The speed required to overcome inertia when starting from stability and the development of explosive power and fast strength of both men due to their exposure to the vocabulary of heavy exercise according to the target time, which has been indicated by many sources that weight training enhances and increases the ability of muscular work, as determining the intensity of running is effective in training and exerting the required force to obtain the appropriate speed endurance, in which the development of strength for the muscles working in running was emphasized and the use of weights added to the upper limbs was emphasized. and the lower and torso during the performance of the exercises by exploiting the target intensity, and this is in agreement with what (Nabila et al.) came to say that "the speed of the strength of the muscles of the legs and their exercises is related to the special exercises that develop the reactions of these muscles in a way that is reflected in the development of the speed, endurance of speed and their production" (Abdurrahman, 1986, p. 25). Significance (0.05) and degree of freedom (5) Since the significance value of the calculated differences is less than the level of (0.05), so there are significant differences between the pre- and post-tests and the post-test was in favor of the post-test in the speed endurance variable, and the reason for this is the effectiveness of the exercises according to the target time of the distance according to its new training context in targeting the ability to endure speed in all its forms of near-maximum load intensity according to the target time indicators, taking advantage of the resistance by using weight added to the body to increase the resistance on the muscles, by relying on Rapid strength training for more or less of the race distance for the purpose of developing the available strength and continuity of the work of the working muscles to ensure the development of the ability to endurance the exerted force and endurance of speed, which positively affected the adaptation of the body's systems in their resistance, as he pointed out (Abdullah, 1984, page 112) that "enduring speed means the struggle against fatigue and its resistance while exerting continuous muscular effort that requires showing increasing speed and energy production." The adaptation of the muscle groups working in the resistance of fatigue and endurance to such tests because they originally relied on distances that are less or greater than the distance of the race, which gave a positive effect in the level of speed endurance: "The most important elements on which the development of the level of speed endurance depends are the endurance capacity, intensity of the distances traveled, and the training methods" (Nassif Q., 1990, p. 257). In the achievement of the (400 meters) event among the sample members, and that the significant differences of the results values after being statistically processed showed the value of (t) calculated by (6.876) and at a significance level less than or equal to (0.05) at the degree of freedom (4) and the significance of this test was (0.002) and since the significance is less than the significance level (0.05), then there are significant

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

differences and this development is a logical result of the moral results of the physical abilities of endurance of forces, endurance of speed and endurance of special performance that have been discussed before, as the focus of the work In the implementation according to the correct scientific foundations, as the training was concentrated in the distances of the least and greater than the race distance, relying on the weighting exercises and then extracting the target time for that distance, it was influential in the development of strength endurance, speed endurance, special endurance and achievement, as training according to the target time, led to the improvement of the endurance of the special runner and at a faster pace than the rhythm of the race, and there had to be repetitions of the special speed training and the special speed endurance with high intensity with the application of the times. The researcher sought through the exercises used to develop speed and endurance of the special speed and improve the sense of the correct rhythm of the steps and by continuing it, so a suitable rest period must be allocated between repetitions so that the runner can maintain the desired rhythm in running during these exercises, and the researcher believes that the exercises he used have achieved an effect on the achievement of the 400 m run, and this indicates that there has been even a slight adjustment in the research sample. In addition, the mechanism and activity of the muscles and the nervous system have improved, and the coordination between them has become good, and this has been shown through the coordination of movements between the parts of the body when continuing to run during the race distance by doing a quick start or increasing the speed that depends on the The ability of the muscle to relax and elasticity is an important factor to achieve high speed according to the conditions of good performance, so these results were in line with the development of the special speed of the sample members, which used the speed endurance and endurance training of the race according to the target time, and this indicates a clear indication of the development of speed endurance and endurance of the special speed The performance of this competition, which has been emphasized through the training curriculum of this competition, has helped to develop these abilities as a result and their speed rates, as practicing exercises that aim to develop speed and special speed endurance makes the athlete possess the effective characteristics of running speed and technical performance for him and helps in the development of harmonic movements of the working joints, which can lead to improving the speed rate, as it can be the right choice for the most exercises. It is appropriate for the type of event to make a transition in the impact of the training to the main movement later." (Adel, 2004, p. 12) Therefore, there were significant differences between the pre- and post-tests and they were in favor of the numerical tests, as the researcher attributes this development to the previous results showed that the weightlifting exercises according to the target time to which the sample members were exposed was effective in the development of speed endurance, special endurance and achievement, as the training according to the target time and strictly determined led to the improvement of the runner's endurance to a faster rhythm than the rhythm of the race, and

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

there had to be repetitions of the training Special speed and special speed endurance with the aim of developing these special abilities, as the goal of the training is to develop speed and endurance of speed and learn to sense the right rhythm

Conclusions

Based on the results obtained in this study, the researcher concluded the following:

1. The experimental training program using weighted exercises had a clear and significant effect on improving the **propulsive index** in 400 m runners.
2. The experimental method using weighting had a clear and effective effect on the development of the 400 m men's achievement.

Recommendations

Based on the findings of the present study, the researcher recommends the following:

1. Conducting analytical studies of a larger number of contributing mechanical variables, conducting pre- and post-tests, designing new training curricula and comparing the results.
2. Conducting analytical studies using a larger number of fast cameras distributed over all parts of the race and in the bows and using 3D analysis to arrive at facts about the small parts of the movement.
3. ϖ The researcher uses weightlifting exercises for relatively long periods to achieve the desired goal.
4. Conducting such research on different age groups to reduce the time difference between distance segments for other running events.

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Appendices

Special Preparation Stage

The stage of developing special endurance according to the target time and some biomechanical variables

Week : First Venue: Maysan Olympic Stadium

Training Module: The First

Training objective: Develop special endurance on pulse : (140 180)

Date:- 2024 / 5 / ؟؟؟؟؟

Day	Exercises	Intensity	Repetitions	Work Time	Rest Between Repetitions	Number of Sets	Rest Between Sets
Saturday	70 m Run	100% of the player's maximum intensity	5	Maximum time for the distance	Work to rest	1	3–5 min
	120 m Run	95% of the player's maximum intensity	3	Maximum time for the distance	Work to rest	1	3–5 min
	150 m Run	90% of the player's maximum intensity	2	Maximum time for the distance	Work to rest	1	—
Monday	200 m Run	95% of the player's	3	Maximum time for the distance	Work to rest	1	3–5 min

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

		maximum intensity					
	300 m Run	90% of the player's maximum intensity	1	Maximum time for the distance	—	1	3–5 min
	450 m Run	85% of the player's maximum intensity	1	Maximum time for the distance	—	1	—
Wednesday	250 m Run	90% of the player's maximum intensity	2	Maximum time for the distance	Work to rest	2	3–5 min
	300 m Run	90% of the player's maximum intensity	1	Maximum time for the distance	—	1	3–5 min
	450 m Run	85% of the player's maximum intensity	1	Maximum time for the distance	Work to rest	1	—

Journal of Physical Education
Volume 38 – Issue (2) – 2026 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

References

Abdel-Fattah, A. A. (2003). *Physiology of training and sport*. Cairo: Arab Thought Publishing House.

Abdel-Basir, A., & Ihab, A. (2004). *Strength training: Integration between theory and practice*. Cairo: Arab Library.

Assaf, A. M. (2002). *Methodological development and the scientific research process* (1st ed.). Amman: Wael Publishing House.

Nasif, A. A., & Hussein, Q. H. (1990). *Sports training science*. Mosul: Printing and Publishing House.

Farhat, L. S. (2001). *Measurement and testing in physical education*. Cairo: Al-Ma'moun Printing Press.

Abdullah, M. S., & Al-Abhar, M. A. (1984). *Physical fitness: Its components and development*. Saudi Arabia: Dar Al-Islah Publishing House.

Abdel-Rahman, N. (1986). *Sciences related to track and field events*. Cairo: Dar Al-Maaref.

Al-Yasiri, M. J. (2001). *Statistical methods in educational research fields*. Iraq: Al-Waraq Publishing Foundation.

Kurz. (2001) Science of sports training .how to plan and control training for peak preference Island pond .V.T. Stadium publishing compan